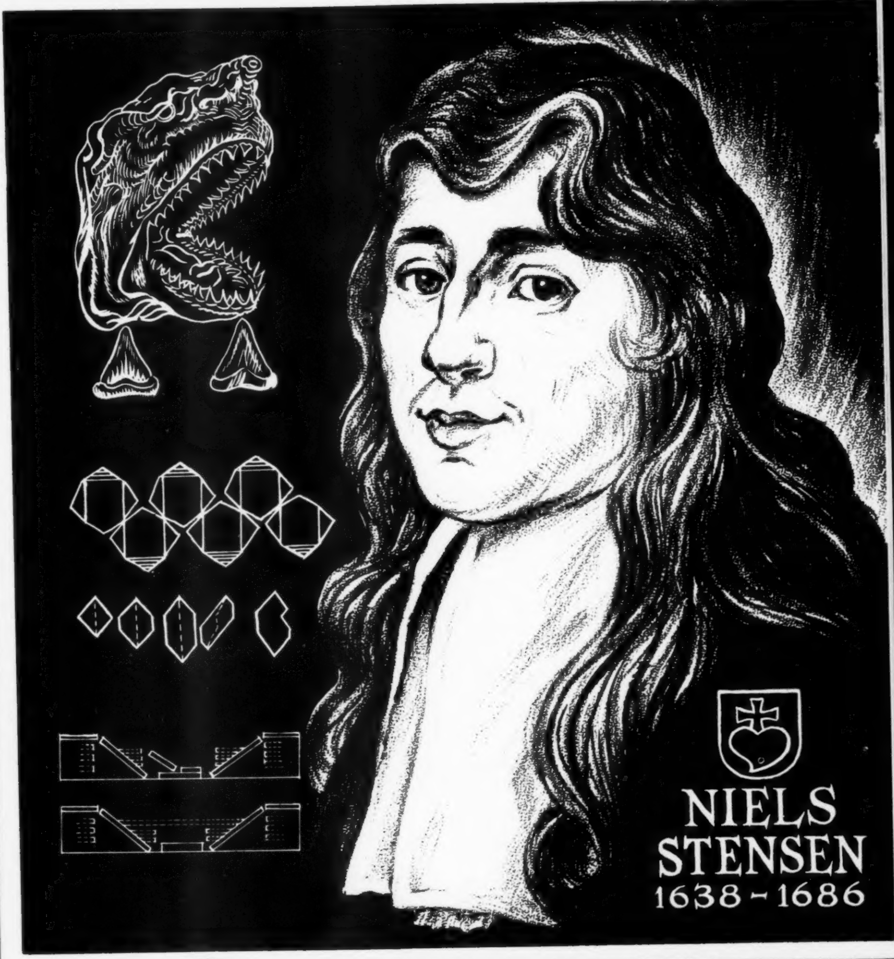
GEOTIMES

Professional News Magazine



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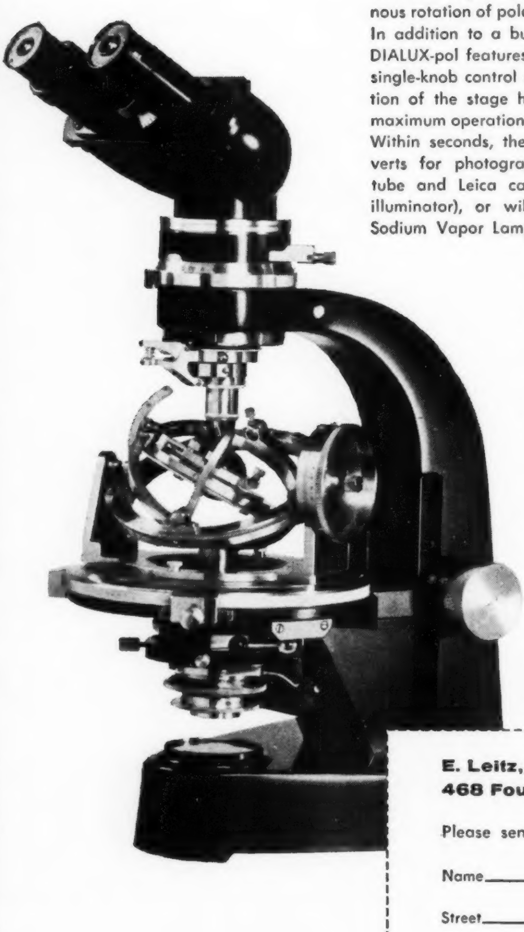

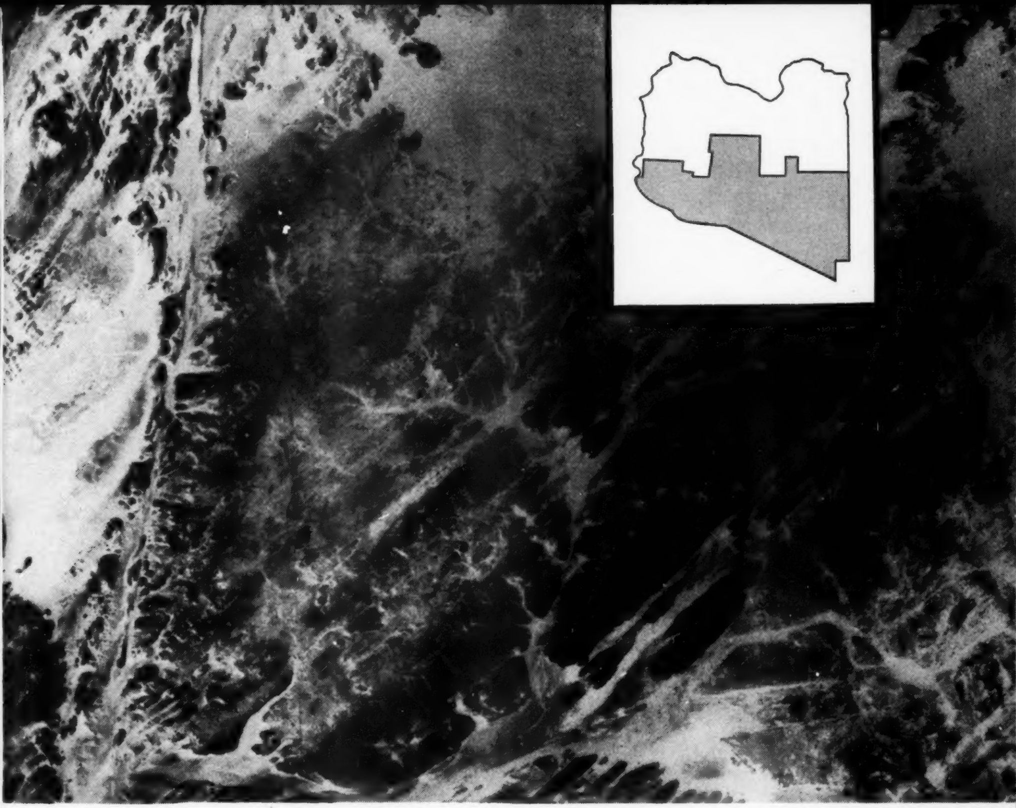

Example of Libya photography

This Month in GEOTIMES

Professional News Magazine

Published by THE AMERICAN GEOLOGICAL INSTITUTE

Robert C. Stephenson, EDITOR

Kathryn Lohman, CIRCULATION MANAGER

VOL. V, NO. 1 JULY-AUGUST 1960

Page

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Calendar

Cooperation of Society Secretaries in supplying meeting notices for GEOTIMES calendar is requested.

July 25-Aug. 6, 1960—IUGG: General Assembly, Helsinki, Finland. Inquire: Sec. Gen. G. Laclavere, 30 Avenue Rapp, Paris 7, France.

*Aug. 6-12, 1960—19th INTERNATIONAL GEOGRAPHIC CONGRESS, General Assembly of the IGU and meetings of the IGU Commission, Stockholm, Sweden. Inquire: The International Geographic Congress Postfack Stockholm 6, Sweden.

Aug. 14-24, 1960—7th INTERNAT. CONGRESS OF SOIL SCIENCE, Madison, Wisc.

*Aug. 15-25, 1960—XXI INTERNATIONAL GEOLOGICAL CONGRESS, to be held at the Mineralogical Geological Museum of the University of Copenhagen in Denmark. Field trips before and after the meetings.

Aug. 20-25, 1960—INTERNAT. MINERAL. ASSOC., 2nd General Meeting; Mineralogical Museum, Univ. of Copenhagen, Denmark.

Aug. 22-26, 1960—2nd ANN. WESTERN RESOURCES CONF., theme, "Water: Measuring and Meeting Future Requirements." Sponsored jointly by Univ. of Colo., Colo. State U. & Colo. School of Mines. Write: Conf. Comm., Chem. Bldg. 305, Univ. of Colo., Boulder, Colo.

Aug. 30-Sept. 2, 1960—ELEVENTH ALASKA SCIENCE CONF., sponsored by AAAS, Alaska Division, Cook Inlet Branch, Anchorage.

Sept. 11-16, 1960—AMER. CHEM. SOC., 138th Meeting, New York City.

Oct. 2-5, 1960—AIME: Soc. of Petr. Eng., Fall meeting, Denver.

Oct. 5-7, 1960—AIME: Rocky Mountain Minerals Conf., Newhouse Hotel, Salt Lake City, Utah.

Oct. 6-8, 1960—9th NATIONAL CLAY CONF., Purdue Univ., Lafayette, Ind. Write: J. L. White, Agronomy Dept., Purdue Univ.

*Oct. 7-8, 1960—ASSOC. OF MISSOURI GEOLOGISTS, Ann. Meeting and field conf., St. Louis, Mo. Write: Dr. Kenneth Brill, St. Louis Univ., St. Louis.

Oct. 12-14, 1960—AAPG: SW Fed. of Geological Soc's., 3rd Ann. Meeting, Wooten Hotel, Abilene, Texas.

Oct. 13-15, 1960—OPTICAL SOC. OF AMERICA, Somerset Hotel, Boston, Mass.

Oct. 14-16, 1960—CALIF. ASSOC. OF ENGINEERING GEOLOGISTS, 3rd Ann. Meeting, Univ. of Calif. at Berkeley. Write: CAEG, P.O. Box 4164, Sacramento 21, Calif.

Oct. 17-19, 1960—BIANNUAL SYMPOSIUM ON DRILLING & BLASTING, sponsored by mining dep'ts. of Univ. of Minnesota, Penn. State Univ., & Colo. School of Mines, Golden, Colo.

Oct. 18-21, 1960—ACerS: 13th Pacific Coast Regional Meeting, Ambassador Hotel, Los Angeles, Calif.

*Oct. 19-21, 1960—GULF COAST ASSOC. OF GEOL. SOC'S., 10th Ann. Convention, Buena Vista Hotel, Biloxi, Miss. Host: Miss. Geol. Soc. Theme: "The Future of Gulf Coast Oil." Technical sessions, entertainment and post meeting field trip. Write: A. E. Blanton, Gen. Chrmn., P. O. Box 422, Jackson, Miss.

Oct. 20-21, 1960—AIME: Los Angeles Basin Sect., Fall Meeting, Huntington Sheraton Hotel, Pasadena, Calif.

*Oct. 31-Nov. 3, 1960—GSA: Ann. Meeting, in conjunction with PS, MSA, GS, SVP and SEcG, Denver Hilton Hotel, Denver, Colo. Field trips before and after the meetings, also local excursions. Write: E. D. McKee, U.S. Geol. Survey, Federal Center, Denver, Colo.

Nov. 3-4, 1960—AAPG: Pacific Section, Ann. Meeting, Ambassador Hotel, Los Angeles.

Nov. 7-10, 1960—SEGp: 30th Ann. Internat. meeting, Moody Convention Center, Galveston. Write: W. B. Lee, Jr., Gulf Oil Corp., Dr. 2100, Houston 1, Tex.

Dec. 2-3, 1960—N.A.G.T., Texas Sect.—Texas Acad. of Sci.; Texas Christian Univ. Campus, Fort Worth, Texas.

Dec. 26-31, 1960—AAAS, Annual Meeting, New York City.

Feb. 10, 1961—12th ANN. SYMPOSIUM ON HIGHWAY GEOLOGY, University of Tennessee, Knoxville; Write: R. A. Laurence, USGS, Room 11, P. O. Bldg., Knoxville 2, Tenn.

(Field Trip Calendar on page 62)

GEOTIMES CALENDAR

Meeting notices for the GeoTimes Calendar should be submitted in concisely edited form to:

Mrs. Kathryn Lohman
GeoTimes Calendar Editor
2101 Constitution Ave., N.W.
Washington 25, D.C.

Geo - Unity

Geologists gathered in Copenhagen for the XXIst International Geological Congress will be assessing the desirability of greater unity of scientists engaged in the study of the geology, the science of the earth. As the oldest of the scientific congresses, the IGC is viewed by geologists with pride because it has stood the test of time without formal organization. In recent years, however, the effectiveness of the informal union, so well-suited to the desires of many strongly individualistic geologists in serving the needs of the geological sciences, has been challenged. The burgeoning demands to attack global problems of geology and of geologists can scarcely be met without the sustained coordination and support of a permanent organization. The 60's cannot be the "Decade of International Geological Research" (DIGR), nor can 1965 be the "Geological Research Achievement Year" (GRAY), without world unity of geologists.

Unity of geologists must be two-dimensional. Obviously there is a great need for global unity of geologists, since geological phenomena have no respect for political boundaries. There is great need, however, for unity in still another dimension—that of scientific specialization. The normal trend is for greater and greater scientific specialization in geology and the fragmentation of geological scientists into smaller and smaller groups. The intense concentration which a specialist brings to bear on his particular area of geological research is unquestionably important to the advancement of geologic knowledge. However, geology is a body of interrelated phenomena, so that when the specialist loses his geologic perspective through overspecialization, his effectiveness as a scientist is adversely affected.

Paleontologists, seismologists, geochemists, stratigraphers, volcanologists and all of the others who form the specialistic groups, on one hand, and the geologists of the many countries of the globe on the other hand, would de well to reflect on the famous quotation from Aesop's *The Four Oxen and the Lion,* "UNITED WE STAND, DIVIDED WE FALL."

Geoscientists must achieve unity today if they are to retain their identity tomorrow.

OUR COVER
Niels Stensen, 1638-1686, born in Copenhagen was responsible for significant early contributions in the emerging science of geology. *Cover by Bruno Figallo.*

The AMERICAN GEOLOGICAL INSTITUTE is a non-profit professional service organization established and managed by the scientific societies in the fields of geology and geophysics in cooperation with the National Academy of Sciences-National Research Council. It is the instrument of the profession serving and advancing the welfare of the geoscientist in matters relating to education, professional responsibilities and government relations. It is an active member of the Scientific Manpower Commission. It also functions in the stimulation of public education and awareness of the earth sciences, through career literature, the scouting program and other channels of communication.

GEOTIMES is the news magazine of the geological sciences. It reports on current events in the earth sciences, public education and public relations efforts throughout the profession, as well as appropriate legislative and governmental issues. It announces scholarships, fellowships, publications and new developments. It provides a forum for discussion of timely professional problems, and affords a common bond between the many specialized groups within the earth sciences

NIELS STENSEN in COPENHAGEN

A historical review of the life and accomplishments of a famous Copenhagen-born scientist.

by

GUSTAV SCHERZ[1]

This portrait of Niels Stensen (Nicolaus Stenonius) by an unknown painter now hangs in the Uffizi Gallery, Florence.

The members of the XXI International Congress of Geology will assemble in August 1960 in Copenhagen, the native town of the founder of modern geology, Niels Stensen (1638-1686), often called by the latinized form of his name: Nicolaus Steno. In eloquent words William Osler, the great American historian of medieval science has called attention to this outstanding scientist saying: *"The Danes have good reason to be proud of the series of distinguished men who have graced the profession of that country in the past three hundred years. No one should have a warmer place in our memory than the anatomist, geologist, and theologian, whose name is on our lips in connection with the duct of the parotid gland."*

The life and work of this great pioneer of science are not well known, partly because he was centuries ahead of his time, yet geologists were among the foremost to rediscover him. While Alexander V. Humboldt and L. Elie de Beaumont in the beginning of the 19th Century already held his work in high esteem, his great historical homage is due to the II International Geological Congress assembled in 1881 in Bologna. Headed by their president Capellini, a thousand geologists had a medallion portrait set up on the wall of the Cloister of S. Lorenzo in Florence (figure 1), near his tomb, which at that time was still hidden in the crypt of the church. The inscription under the portrait runs in Garret Winter's translation as follows:

Friend you behold the likeness of Nicolaus Steno. To it more than a thousand men of learning, from all parts of the world, contributed. They made provision for the carving of it in memory of this day, the twenty-eight of September, in the year 1881, when the Geologists, after the Congress in Bologna, under the Presidency of Cavalier Giovanni Capellini, journeyed hither, and in the presence of delegates representing the city of Florence and the Royal Institute of Higher Studies, in the cloister of this church, as a testimony of respect and gratitude honored with a laurel crown a man of surpassing distinction among Geologists and Anatomists."

The several thousand geologists gathering in Stensen's native town for the XXIst Congress might ask where in Copenhagen

[1] Gustav Scherz, CSSR, is a historian of science and an authority on Niels Stensen. He received his Ph.D. from the University of Copenhagen and has been awarded the degree of Dr. theol. honoris causa by Munster University in Westphalia. During the first half of 1960, Fr. Scherz was a visiting professor in the United States.

Figure 1. Photograph of the plaque honoring Steno which was placed in the cloister of S. Lorenzo, Florence by an assemblage of 1000 geologists gathered in Bologna for the II International Geological Congress.

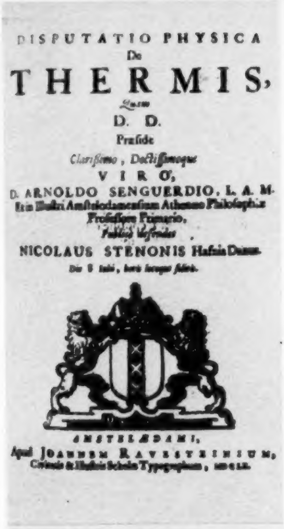


Figure 2. Title page of Stensen's first published thesis, The Hot Springs, a mineralogical problem, which was publicly defended in Amsterdam in July 1660, just 300 years ago. The only known copy of this was found in Philadelphia in 1959.

may historical traces of this Copenhagener be found. As in Florence, they will, strangely enough, not find any memorial to him, though Danish historians of science do rank him as probably the greatest among Danish naturalists. Yet there are a dozen places in Copenhagen where Steno-friends, especially when assisted by etchings and inscriptions of the 17th Century, may come on such Steno-memories.

Steno Duct

Before guiding our readers to such places, it is appropriate to discuss the question as to why Niels Stensen is regarded as one of the greatest scientists, and to review those geological discoveries credited to him. The Danish scientist, for the multitude of his new observations and fundamental discoveries, has been compared with old King Midas of Crete, who was said to change to gold whatever he touched. His fertile research began after Stensen's early years in Copenhagen, when he had left Denmark in 1660, in order to study in Holland. By examining a sheep's head in Amsterdam, he came upon his above-mentioned first discovery, that of the Steno-Duct, or duct of the parotid gland providing the mouth with most of its watering so necessary for digestion. This discovery started his comprehensive work on glands and muscles in the following four years, spent mostly in Leiden. He gave an account of the secretion of tears and the whole

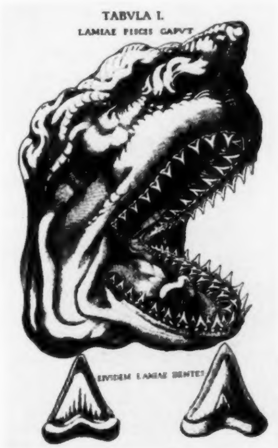


Figure 3. Copy of a plate from Stensen's "Canis Carchariae caput dissectum" showing the head of a shark (Carcharadon Rondeletti) and shark's teeth. He took this plate from M. Marcati's manuscript of Methallotheca Vaticana.

lachrymal system. He found numerous glands in the mucous membranes of the nose, gums, and throat, and declared all secretions to be products of the arterial blood, among them, particularly milk. In the same way, he did his revolutionary

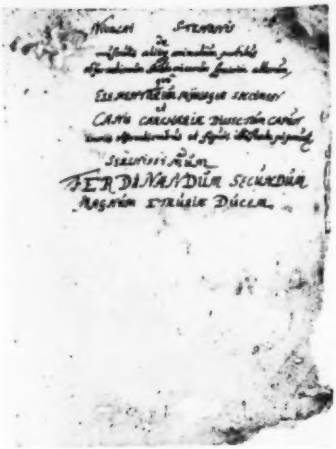


Figure 4. Title page of the printers manuscript of Stensen's "Elementorum myologiae specimen," including his treatise on his shark dissection. The manuscript is now in the Royal Library of Copenhagen.

NICOLAI STENONIS
DE SOLIDO
INTRA SOLIDVM NATVRALITER CONTENTO
DISSERTATIONIS PRODROMVS.
AD
SERENISSIMVM
FERDINANDVM II.
MAGNVM ETRVRIÆ DVCEM.

FLORENTIÆ
Ex Typographia sub signo STELLÆ MDCLXIX.
SVPERIORVM PERMISSV.

Figure 5. Title page of the Prodromus, Stensen's pioneering treatise on the geology of Tuscany: "On bodies naturally enclosed in other bodies." The coat of arms, with the rose and thorns, is that of the Grand Duke Ferdinand II of Medici.

studies on the muscles and the heart, rejecting the old Galenic view of the muscle as an indistinguished mass of flesh. When in 1664 he returned to Copenhagen, in the work *"Observationum anatomicarum specimen,"* his "golden booklet," as Albr. V. Haller called it, he offered his king, Frederik III, the results of his ingenious research in the hope of a professorship at the university. Yet another candidate, by far his inferior, was preferred to him and Stensen left Denmark again.

In Paris, in the circle of M. Thevenot, he became associated with the founders of the Academie des Sciences and there delivered his famous lecture on the anatomy of the brain. Rejecting the errors of his time, he outlined a working plan for future brain research, still followed by today's anatomists, and he showed the faults of Descartes' brain biology. At the end of the year 1665, in Montpellier, he met some of the most influential British naturalists of his time, including Martin Lister, John Ray, and William Croone. They were highly appreciative of his work and were responsible for acquainting the newly founded Royal Society and British science in general with it.

Shark's Head

Just as Stensen's anatomical discoveries were started by the head of a sheep, his foundation of paleontology, geology and crystallography was begun by the head of a shark. In the beginning of 1666, he had been warmly received by the Grand Duke Ferdinando II in Florence, and he soon became associated with the members of the Accademia del Cimento, which in a way was the first experimental academy and the spiritual daughter of Galileo. At the end of this year, 1666, an enormous shark, a *Carcharadon Rondeletti,* was dragged ashore near Leghorn, and the head of it was given to Stensen for dissection. He probably did this historical dissection in the old hospital of Santa Maria Nuova where he had been appointed anatomist.

Now he compared the rows of hard and soft shark teeth with the bodies that at his time often were called "glossopetrae" or tonguestones. These had been found in great number on the island of Malta, and they were mostly regarded to be either the product of a "plastic power of the earth" or as freaks of nature. Stensen recognized them to be petrified shark teeth, and he went on to assert the organic origin of fossils in general. In his treatise (1667) on this dissection: *"Canis carchariae caput dissectum,"*[2] he presented

[2] "Caput dissectum" was not published separately, but was added to *"Elementorum Myologiae Specimen, Seu Musculi descriptio Geometrica,"* Stensen's great work on muscles published in 1667. Indeed, the biological form of

in eleven brief sections (historiae) his observations on facts about these teeth and on the materials in which they were found (Figures 3 & 4). Then in six "suppositions," he pointed out the logical results and deductions from those facts. In the last supposition, he stated: "*Since the earth, from which the bodies resembling parts of animals have been dug out, does not produce such bodies in our time, and since it is likely that the soil in question was soft in former times, indeed, presumably has been mixed up with waters, why then should we not be allowed to surmise that these bodies are the remains of animals which lived in the waters. Indeed, if we examine their position in the strata, it does not seem possible that they could have come together in this way unless they may be said to have been laid down little by little in the sediments of the water.*" In this passage he offered to science the golden key of paleontology and also indicated that he had begun to understand the language of the sediments.

Prodromus

Continuing his research in the crust of the earth of Tuscany and Italy, Stensen in the summer of 1668 wrote his most famous treatise the "Prodromus, a dissertation on bodies naturally enclosed in other bodies" (1669), Figure 5. We must remember that at the same time he was occupied in several other ways, giving great contributions to myology, comparative anatomy and embryology. Moreover, he went through a severe religious crisis, which had led to his conversion on All Souls' Day 1667. Yet this "forerunner" to a dissertation (which was never written) contains so many new observations and views that Charles Lyell says: "From the contents of the Prodromus a work might be composed under the title: "Principles of Geology."

In this preliminary report, written in great haste, as the author expected to be called back to Denmark, Stensen first of all stated important principles with regard to the method of science and geology. Of Stensen's scientific method in general William H. Hobbs says: "One of his statements might well be printed in large letters and placed upon the walls of our laboratories and lecture rooms as a warning to those who undertake scientific investigation." "*The nurse of doubts*" says Steno, "*seems to me to be the fact that in the consideration of questions relating to nature those points which cannot be definitely determined, are not distinguished from those which can be settled with certainty.*" How much trouble would be saved if today's scholars oftener had this point in mind.

Stensen also showed his clear understanding of strictly geological methods. Dr. H. Oedum in 1938 called attention to the fact that Stensen followed the method now called actualism, when stating: "*Given a substance possessed of a certain figure, and produced according to the laws of nature, one should find in the substance itself evidences disclosing the place and manner of its production.*" Relying on the constancy of nature's powers, he, for instance, discusses the origin of the strata from place to place as results of water sediments or volcanic eruptions.

Observations on Strata

Once more investigating the origin and nature of fossils and the layers in which they were found, Stensen stated one of the most important geologic principles. "*The strata of the earth*" he said, "*are due to the deposits of a fluid making this evident by the bodies found in them.*" Also rocks result from sedimentation, he said, "*since these strata of the earth, as regards the manner and place of production, agree with those strata which turbid water deposits.*"

Stensen then stated the important principle of the original horizontality of sedimentary formations. We also owe him the other observation that the order of superposition of beds determines the age of the formations: "*At the time when any given stratum was being formed, all the matter resting upon it was fluid, and, therefore at the time the lowest stratum was being formed, none of the upper strata existed.*"

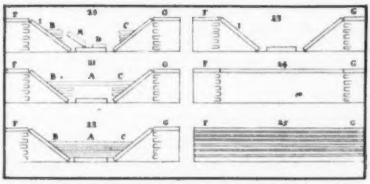


Figure 6. Six successive stages in the geological history of Tuscany from Steno's Prodromus (Florence 1669).

Origin of Mountains

Speaking of the origin of mountains,

the "Myologiae;" its rarity, and the nongeological title of the following "Canis carchariae" obscured the great geological importance of the latter until relatively recently.

Figure 8. A map of the center of modern Copenhagen. The numbers in red refer to Steno-significant sites which are described in the text.

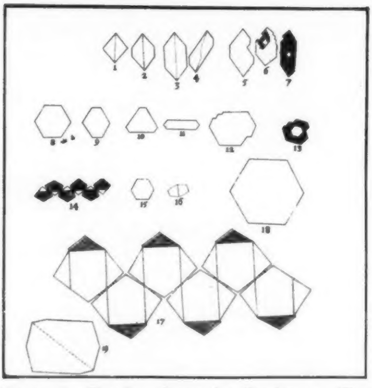


Figure 7. Sketches from the Prodromus (Florence 1669) by Steno accompanying his discussion of the constancy of interfacial angles of crystals.

he declared the changes in position of the strata to be the chief cause of mountains, and he pretty clearly distinguished three of the more important mountain types; namely, 1) block or fault mountains, 2) volcanic mountains, and 3) mountains of erosion.

In the fourth part of the Prodromus, Stensen, making practical use of his principles made the first attempt historically to understand the geological developments of a district, presenting an outline of the geological evolution of Tuscany—a really outstanding achievement in the history of geology (Figure 6).

Under his discussion of the origin of mountains, Stensen also investigated the origin of ores and crystals, and at once came on fundamental crystallographic observations, which are perhaps his greatest contribution to science (Dr. Hobbs).

Constancy of Interfacial Angles

With regard to the growth of crystals he showed that they grew by apposition, i.e., by accretions of substance upon the surface of the crystal, and not as do plants and animals by intussusception. Declaring the crystals to be products of fluids he observed the direction of their growth (anisotropy). As to their structure he, of course, could not have any real conception of atoms and molecules, yet he did point to the striking particularity of light refraction that distinguished the

crystal from amorphous substances such as glass. Stensen also discovered the fundamental law of crystallography, stating the constancy of interfacial angles in crystals of the same mineral. From the days of antiquity and until the 17th Century crystal classifications were based almost exclusively on color and luster. Stensen (Figure 7), explaining the figures in his Prodromus said: *"Figures 5 and 6 belong to the class of those crystals which I could present in countless numbers to prove that in the plane of the axis both the number and the length of the sides are changed in various ways without changing the angles."*

The clear and basic understanding of Stensen's geological-mineralogical observations and principles, gained in two short years may best be realized from the fact that after his long journey in 1669-70, which led him across the Apennines and Alps, through Tyrol and Austria, to the gold and silver mines of Hungary and the hot springs of Bohemia, he felt no need to change any of his first observations and statements made in Italy. Of Stensen's crystallographical discoveries, H. Tertsch, from his expert knowledge of the history of this science has this to say: "In our day, disposing of an almost innumerable plenty of investigations into crystals with regard to their morphological, physical and chemical composition, able to reveal their finer structure and more and more recognizing that all properties of crystals finally depend on their structure, today we must with honest veneration ascribe to Stensen the merit to have laid the foundation of crystallography in its most comprehensive sense."

Stensen's Copenhagen

Returning now to Copenhagen, we will realize that most of this scientific pioneering work, as mentioned before, was done by Stensen outside his native country. Yet great men's childhood and first development always form an important and interesting chapter of their biographies, so Steno's friends in Copenhagen today may look quite naturally for the places where the foundations of his life and work were laid: in the circle of his family, at the old Latin school, at the University, and last but not least amidst inspiring friends of the young man. As a matter of fact many of those places have disappeared. Copenhagen in Stensen's day was a town of about 25,000 citizens, who from their ramparts had to defend the independence of their country against the Swedes. Since then it has suffered several times from fire and warfare, yet the plan of the old, central part of Copenhagen has been preserved essentially as it was in the Middle Ages.

The map (figure 8) will lead Congress visitors to those places still existing today. We may start in Klareboderne (1), where Niels was born on New Year's Day, 1638 (figure 9). This little lane, a sidewalk from the main traffic line, Koebmager Street led at the end of the Middle Ages up to St. Clara's Convent, founded in 1497 and destroyed after the Reformation (figure 10). Many years later the world traveller's thoughts apparently still wandered back to his place of birth, for as a bishop in Hamburg, Stensen on August 12 (the day dedicated to St. Clara) in 1864 finished a letter to his Medici-Maecenas Grand Duke Cosimo III remarking that it was St. Clara, *"through whose intercession I expect particular help, because in my native country, I was born in a lane that still carries her name."*

In this lane of Klareboderne Stensen's father, goldsmith Sten Pedersen, had his shop. Here his mother Anne tried to secure the future of the family's work and craftmanship as Stensen's father died while the boy was hardly six years old. In the following twenty years, the widow successively married three other goldsmiths and outlived them all before she herself was buried at their sides. Besides, the family also owned a house on Koebmager Street (2), the main street. When in 1672 the famous scientist came home again, he probably stayed in this house as the guest of his only sister, Anne, and her husband, goldsmith Jacob Kitzerow. Stensen's private dissections as a Royal Anatomist called home by Griffinfekd, the tragic chancellor, took place in Kitzerow's townhouse in Studiestraede (3) near the old University center. Those dissections were described by his pupil Holger Jacobaeus, and the manuscript may still be seen in the Royal Library (4) of Copenhagen, where you also may find some handwritten letters—one in Danish—and the valuable printed manuscript of Stensen's *"Elementorum myologiae specimen,"* which a California antiquarist sold to the library a few years ago.

Near the southern end on Koebmager Street the church of St. Nikolaj (5) is still to be seen. It is dedicated to St. Nicolaus, the patron of the shippers. Only the basic walls from the 17th century

Figure 9. Niels Stensen's birthplace is believed to have been in a house which in medieval times stood on this site which is at the intersection of Koebmagerade and Klareboderne in present-day Copenhagen.

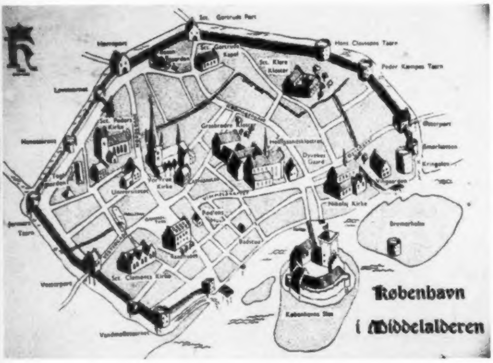


Figure 10. Copenhagen in the Middle Ages, a sketch map showing on the island, Det Kgl. Slot (the Royal Castle); at the northeast wall. Sct. Klara Kloster (St. Clara's Convent) next to the castle, Nikolaj Kirke (St. Nicolaus' Church) and the high tower in the center, Vor Frue Kirke (Our Lady's Church).

are still preserved (figure 11). In this church Niels probably was baptized, and here he often may have looked up at the golden statue of his patron at that time standing at the rear of the church. His whole family apparently was connected with this church. The registers of the archives of the town hall reveal that his father and mother and many of his relatives were buried in the Crypt of St. Nikolaj.

As little Niels had been interested, no doubt, in his father's workshop, he certainly also was impressed by the metals, lenses, tools and jewels, jugs and plates, knives, forks, spoons and chalices which the craftsmen of Klareboderne provided for the court and ROYAL CASTLE (6) of Christian IV (1588-1648) and Frederick III (1648-1670). Some basic walls of this old castle are still preserved and may be seen under Christiansborg, where the Danish Folketing, the House of Commons, has its seat. Here too some stone walls of the Castle of Absalon, the founder of Copenhagen, are still preserved. Just as the supplies of silver and gold vessels for the court may have led the boy's fancy to the Royal Castle, so also did the work of his brother-in-law, Joergen Carstensen, married to his half-sister Lisbeth, who was in the King's finance service and had a house not far from the castle. His stepfather, Joergen Stichman, prominent citizen, was certainly present in 1660 when the new constitution of the absolute kingdom was solemnly presented for the public in front of the castle, near the NEW EXCHANGE (7), one of the buildings in Dutch renaissance style by which Christian IV gave Copenhagen its characteristic features.

At the opposite end of Koebmager Street, THE ROUND TOWER (8) is perhaps the best known building of Copenhagen (figure 12). It was begun just as Niels was born and finished some four years later. It may remind the tourist of the age of Danish science, the rise of which began with the astronomer Tycho Brahe. Although it was called "The Castle of the Stars" it was neither well-suited nor much used for astronomical purposes. Young Niels, born near by and often passing by, certainly must have been impressed by the building on his daily way to the Latin School and University.

The educational institutions in which

Figure 11. St. Nicolaus' Church at the end of the Middle Ages, a modern artist's reconstruction. (Location No. 5 on fig. 8.)

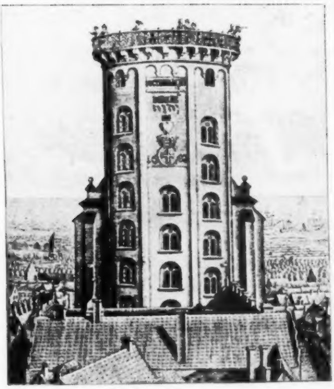


Figure 12. Rundetaarn (the Round Tower) was built by King Christian IV in the years 1637-1642 and originally used as an observatory. (Location No. 8 on fig. 8.) Photograph of a sketch made in 1657.

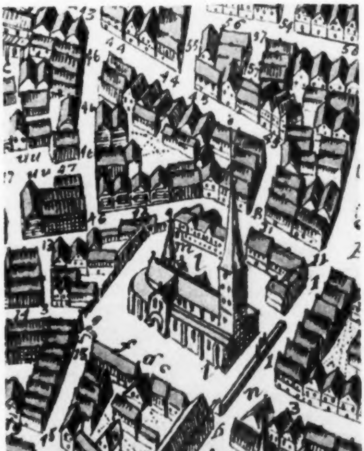


Figure 13. Vor Frue Kirke og Kirkegaard (Our Lady's Church and Churchyard) from a bird's eye view sketch by Peder Resen in 1674. m: Our Lady's School, d: Domus Anatomic, 3: Studiestraede, 14 and 15: professors' residences.

Stensen, the student, received his instruction in the years between 1648 and 1660 were located on the square around Our Lady's Church. Most of the buildings have, in the course of time, been replaced; yet, Resen's map of 1674 (figure 13) gives a good impression of the situation in Stensen's time. There was the old OUR LADY'S SCHOOL (9), the Latin School on the north side of the church (now called Metropolitan School) which has been moved to the outskirts of the town. Here the boy met such inspiring teachers as Joergen Ejlersen, the mathematician, and Ole Borch, the humanist, botanist and chemist (figure 14). During Stensen's childhood the DOMUS ANATOMICA (10) was erected to the south of Our Lady's Church. The physician and botanist Simon Paulli held sway in this building (figure 15). He became a fatherly friend of little Niels and in his house near the University campus the child often met the professor's children and was brought up together with them.

How much anatomical work the student saw and did in the anatomical theater is not easy to decide, though he had such an outstanding anatomist in his university years as his preceptor Thomas Bartholin, the discoverer of the lymphatic vessels in man. Yet the years of war with Sweden (1657-1660), with Denmark under long siege, it was a poor time for studies. The students, together with the citizens, had to defend their town especially on the famous night of February 10 when Carl Gustaf tried to take the town. The place where the students served their country with their swords was near the present STORMGADE (11) and the National Museum.

In 1673, however, Stensen used the Theatrum Anatomicum as a "Royal Anatomist" for his only great public demonstration, in Copenhagen. There he dissected for the students a female body and summarized his ideas on the entirety and beauty of life in the famous sentence: "*Beautiful is that which we see, more beautiful that which we know, but by far the most beautiful that which we do not comprehend.*"

In or near the Domus Anatomica was another symbol of the era's interest in natural history. Ole Work had assembled a collection of well-described curiosities in MUSEUM WORMIANUM (12) which young Stensen certainly had seen. Exhibited in the museum were "tonguestones" brought from the island of Malta. Only seven years later a plate in his first geological treatise compared fossils such as these with the teeth of the shark he dissected in making his important paleontological observation.

(Continued on page 56)

THE NEXT HUNDRED YEARS ENERGY DEMAND & SOURCES OF SUPPLY[1]

by LEWIS G. WEEKS[2]

1959 was the Petroleum Industry's Centennial Year, and we have been doing a lot of looking back at where we have been. It might be of interest to attempt to look ahead at where we may be going during the next century. Whence will come our energy in the year 2059? Some of it will be coming from the same sources it is coming from now, though the progress of the past 100 years will be multiplied many times within the next hundred. Shortly after the year 2000, however, or say in another 50 years, other presently undeveloped sources of energy will have begun to supply a total energy demand that will, by then, be more than seven times what it is today.

In any forecast it is necessary to make certain assumptions. It is assumed that there will be no disastrous or catastrophic event or events of natural origin, or of man's own making, which will materially alter the curve trend of energy demand of the past 100 years. On the other hand, it is assumed that the acceleration of the trend will not be significantly greater than that which we are having now.

This brings us to another basic assumtion; that is, that there are no limits to man's ability to find a way to utilize an existing potential resource so long as the need to do so prevails. He will, if and as necessary, find an economical way to recover energy from the vast reserves of low grade oil shales and from thin and deep-lying coal seams. He will, if he chooses, find a way to harness and transmit solar energy, even from outer space. He will, if necessary, develop means for making use of geothermal energy (the internal heat of the earth) and energy differences within the earth. He may do the same with tidal energy. He will learn how to free and utilize more and more the energy of the atom, the sources and supplies of which are far beyond our capacity to imagine.

POPULATION GROWTH

It is a popular practice to base forecasts of demand on estimates of population growth. From 10,000 B.C. up to about 1500 A.D. this growth was very slow; at times it even reversed itself. Approximately 400 to 500 years ago growth began to gather momentum, first here, then there, and it has been irregularly explosive in its rise since. Annual rate of growth increased from about one per thousand around the year 1500 to about 12 per thousand today. And the rate of population increase is now growing faster than ever.

In spite of the many attempts to explain the causes of population growth and growth variation these causes remain obscure. It is believed that three forms of energy, working in combination, have been the important factors. First, there is the energy that is in food. It is impossible to overemphasize the importance of the effect upon peoples of an adequate supply of food and, far more important, a properly balanced diet. Second is the tremendous wealth of energy which man has obtained from the fossil fuels. Since the dawn of creation he has had to depend entirely on sun-derived energy. In addition to that contained in his food, this energy has been obtained notably from water power, wood, coal and petroleum. When someone discovered seven or eight centuries ago, that certain black rocks in England would burn, the basis was laid for advances in metallurgy,

1) Due to space limitations much explanation has been omitted from the text of this article.

2) LEWIS G. WEEKS, Consulting Geologist, Westport, Connecticut. Mr. Weeks is past president of the American Association of Petroleum Geologists.

Figure 1

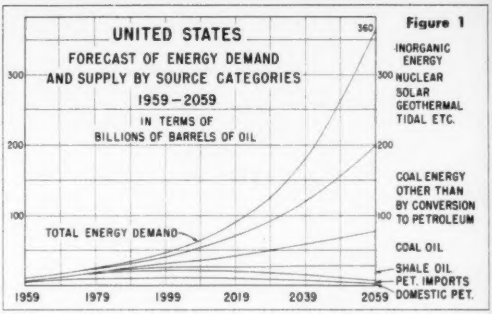


Figure 2

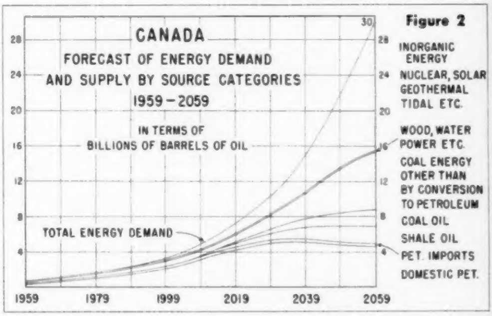
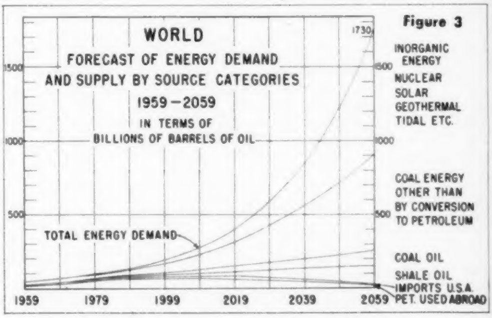


Figure 3



radical inventions, the Rennaissance and the Industrial Revolution. Peoples with peasant occupations and local markets were transformed into industrial societies with world-wide connections. Because of the adventurous spirit of her peoples, England was the pioneer. Third, and equally important, is the energy which has been awakening in the spirit of man. This energy of the spirit accounts for his inventive genius, which is what led him to tap the power stored in coal and petroleum, and is now leading him to seek the unlimited stores of power held in inorganic energy sources. The effect of the three forms of energy is not in proportion to the sum thereof, but to their product.

It seems reasonable to assume that the curve of population growth for the past 200 years will continue the same growth pattern for another 100 years. On this basis, we may anticipate a world population of the order of seven billions by the year 2059, or nearly three times the present population of 2.5 billions.

Population increase and an acceleration in per capita demand for energy—particularly in large areas of the world where use today is comparatively limited—will produce a total demand for energy in the year 2059 of at least 40 and perhaps as much as 50 or more times that of 1959.

Figures 1, 2 and 3 give this forecast of total energy demand for Canada, the United States and for the world over the 100 years period. It is sufficient to note at this point that the upper or total energy demand curve indicates that demand for energy will a little more than double every 20 years.

Sources of Energy Supply

For a forecast such as this, one has first to take inventory of our energy supplies. For an estimate of sources of energy supply the writer has preferred to rely on his own studies. This is particularly true with respect to the fossil fuels (oil, gas, coal). With regard to the inorganic sources of energy, such as nuclear, solar, geothermal etc., the potential supply is unlimited so far as man is concerned, and there is, therefore, no need for an estimate.

The categories of energy supply from organic sources are listed in Table 1, along with an estimate of the amount of the potential supplies. All energy figures are in terms of billions of barrels of oil or equivalent. As BTU values of all fuels vary, it is believed that for purposes of an estimate of this nature the more familiar barrel of oil is as good a unit of measurement as any one might select.

Ultimate Oil Supply by Conventional Production Methods

The estimate of 2000 billion barrels of total ultimate liquid petroleum from the land and water areas of the world includes 85 billion for Canada and 270 billion for the United States. Table 2 gives a breakdown of these figures by major world subdivisions.

In connection with his estimates of ultimate petroleum resources made during the 1940s, the writer stated that the figures were believed to be very conservative. Those figures also did not include the oil from the water areas of the world, which will no doubt produce several hundreds of billions of barrels of oil. Nor did they

ESTIMATED POTENTIAL ENERGY SUPPLIES – 1/1/59
FROM ORGANIC (LIMITED) SOURCES

Table 1 (IN TERMS OF BILLIONS OF BARRELS OF OIL)

	CANADA	U.S.A.	WORLD
CONVENTIONAL ULTIMATE OIL	85	270	2,000
OIL PRODUCED	1.3	64	100
OIL REMAINING	84	206	1,900
SECONDARY OIL	75	190	1,500
TAR SANDS	300	10	1,100
GAS	56	164	1,000
SUB-TOTALS	515	570	5,500
OTHER SOURCES			
SHALE OIL	500	2,000	12,000
COAL	4,200	14,000	55,000
WOOD, FARM WASTE, WATER POWER ETC.	14	50	500
TOTALS	5,229	16,620	73,000

include the petroleum gas liquids, which may total as much as ten percent of the primary recovery. All of the writer's estimates, including the earliest which were published by others, were not made for publication but for the purpose of quantitatively rating the basins of the world. This purpose requires only that the figures be of comparable magnitude. All of the published totals represented in round numbers a summation of the individual ratings for the hundreds of basins or basin areas about the world.

Basins are rated quantitatively in terms of oil because the method forces study, analysis and thinking. By this means others know what one has in mind, and a common basis for discussion is provided. This cannot be said of such noncommittal or widely interpretable classifications as good, fair, poor, or A, B, C, D etc. The comparisons with hundreds of other areas, or even with a few areas that are afforded by quantitative appraisals, are a powerful means of checking up on one's thinking and analysis. Estimates of ultimate potential cannot be arrived at by any form of pure mathematical calculation. The only basis that has any merit is that of exploration experience, scientifically analyzed. The basis of experience should be as wide as possible, preferably worldwide. It should take into account experience with the many already explored geological situations in basins of the same class and character, particularly those conditions that are similar to each of the several (or many) conditions that are existent in the basin, area, province or region under analysis. These estimates need to be revised from time to time, as new facts on oil occurrence, both local and in general develop, just as is done with our proved reserve estimates.

The first totals of the writer's rating figures that appeared in print gave approximately 610 billion barrels of oil for the world. In his own publications later[3] it was pointed out that "the actual measure of total world oil recoverable by conventional methods and under present economics is more likely to be 50% larger than 10% smaller" than the published figures indicated, and also that "the actual figure of ultimate reserves may vary by considerably more than the percentages cited." A 50% addition to the 610 billion barrels would give a figure of 915 billions. To this we may add 400 billion barrels for the water areas of the world. Thus we arrive at a total of 1315 billions. A ten percent increase for petroleum gas liquids brings the total for those early estimates to 1446 billions, which is on a comparable basis with the 1500 billion barrels used in the writer's note of February, 1959.[4]

There are those who prefer to see no limits put on the amount of petroleum that can be made available. Partly to meet this stand, it was decided for purposes of this forecast to use the figure of 2000 billion barrels of oil for the world, 270 billions for the United States and 85 billions for Canada as the amount of ultimate oil supplied by conventional methods, rather than the somewhat lower figure. However, to justify such high figures at this stage may stretch the imagination of those who are best informed. The 85 billion barrels figure for Canada is tentative because of the inadequate information on the Arctic basins.

Actually, the quantities of hydrocarbons and other bitumens in the earth are far greater than man will ever use. This is true of all our natural resources. By no means all of the hydrocarbons will ultimately constitute reserves, however. What proportion of the huge total will become proved reserves will depend on how far into occurrences of lower and lower grade it will be economical for man to delve. If governments take away industry's depletion allowance for a few tax dollars today it will greatly cut into reserves and the cost of fuel over the years ahead.

[3] L. G. Weeks. "*A Discussion of Potential Oil Reserves*," presented at Lake Success in August, 1949 and published in "*Proceedings of United Nations Scientific Conference on the Conservation and Utilization of Resources.*" Volume 1, Plenary Meetings, United Nations, 1950.

See also "*Concerning Potential Oil Reserve Estimates.*" *Bulletin*, American Association of Petroleum Geologists, Volume 34, No. 10, October, 1950.

[4] L. G. Weeks, "*Fuel Reserves of the Future*," *Bulletin*, American Association of Petroleum Geologists, Vol. 42, No. 2, February, 1959.

Other potential sources of energy supply are the following:

Secondary Recovery

Estimates of 1500 billion barrels of secondary recovery oil are thought to be of the right order of magnitude. The figures may seem low by comparison with the estimates for primary recovery. However, it is felt that, as time goes on more and more of the original oil in place will be recovered by the primary methods.

Tar Sands

Tar or heavy oil sands are widespread. Deposits are huge in several countries, such as Canada, Venezuela and the Middle East. As shown, they are not comparatively large in the United States.

Petroleum Gas

Potential unproduced reserves of petroleum gas are estimated at 336 trillion cubic feet for Canada, 1000 trillion cubic feet for the United States and 6000 trillion for the world. For conversion, 6000 cubic feet of gas was considered to have the energy equivalent of a barrel of oil, thus giving the equivalents in billions of barrels of oil shown in Table 1.

Oil Shales

The total amount of bitumen that is locked up in the clay and lime muds of the geologic past is fantastically large. However, probably only the richest of these, now lithified muds will be commercially exploitable by any method to be devised, and hence constitute reserves within the next 100 years. Possible potential resources of such shales are estimated at 500 billion barrels of oil for Canada, at 2000 billion barrels for the United States, and for the world on the same basis at 12,000 billion barrels.

Under today's economics commercially proved world reserves of shale oil comprise but a few scores of billions of barrels, and are probably not over 150 billion barrels. A strong deterrent to the ready development of oil from shales is the present unavailability of the very large capital requirements.

Coal

On the basis of the assumptions made at the outset, estimated remaining potential coal resources are of the order of 600 billion tons for Canada, 2000 billion for the United States and 8000 billion for the world. For conversion, an average ton of coal, on hydrogenation, was assumed to be the equivalent of eight barrels of oil, or of six barrels of oil converted to energy directly without hydrogenation. An average of seven was used for conversion of all coal to crude oil equivalent energy. It was thus that the figures of 4200, 14,000 and 56,000 billion barrels of oil equivalent shown in Table 1 were arrived at for Canada, the United States and the world respectively. To be sure, fully three-fourths of these quantities of coal do not constitute reserves under substantially present methods of exploitation and economics. There exist, for instance, vast deposits of lignite or low grade coal that are not now commercially exploitable. And there are very large amounts of coal occurring in seams that are too thin or too deep for economical use today, but which will eventually become utilizable by some such method as *in situ* energy extraction, robot mining etc.

For purposes of this 100 years forecast the coal figures set up are believed to be reasonably conservative. We do not yet know how much credence can be given to some of the large new claims being made of coal reserves in the U.S.S.R. and in China.

Wood, Farm Wastes, Water Power

Up to about 20 years ago more energy was obtained in the world from farm wastes than from hydrocarbon fuels. This fact may be difficult to realize in countries like Canada and the United States, but huge quantities of these wastes are used in Asia, east and southeast Europe and even in South America. Today, farm wastes still contribute between 10 and 15 percent of world energy requirements, or close to three times that provided by wood. While the use of wood and farm wastes will grow a little in some areas, on the whole they will be partly replaced by more convenient forms of energy.

About 70 percent of available U. S. water power is being utilized today to provide less than two percent of our energy needs. Corresponding figures for Canada were not obtainable. As water power is tied in with flood control and land reclamation projects it generally requires large capital expenditures. For Canada, the United States and the world at large, it is estimated that the decline in the use of wood and farm wastes will be roughly offset by an increase in the use of water power. Thus, as in the past 100 years, the total energy utilized from these largely renewable sources may re-

(Continued on page 51)

THE PROGRESS OF GEOLOGY in the U.S.S.R.[1]

by S. I. Tomkeieff[2]

Summary

This brief survey of the development of geology and of the teaching of geology in the Soviet Union is the first of its kind in English and is intended merely to introduce the subject and to induce English geologists to learn Russian and so make available for themselves the immensely rich scientific resources of the U.S.S.R., or failing that, to make themselves acquainted through the medium of abstracts and translations with the geological work being done in the U.S.S.R.

The article is intended as a guide and it comprises sections dealing with the history and multifarious branches of geology as it exists in the 1950's. There is space only for major developments in the organization of teaching and research, and for outstanding contributions to the science of geology, associated generally with the names of the principal geologists of the U.S.S.R. The article also includes very brief bibliographical references.

Introduction

In Russia, as in other countries affected, the early phases of the industrial revolution in the late 17th and early 18th centuries were marked by the gradual evolution of the science of geology from the fund of empirical knowledge which had hitherto been the preserve of miners and quarrymen. The mining of the ores of iron, copper, silver and gold in the U.S.S.R. dates from early historic times, but the systematic exploration and exploitation of the mineral wealth of Russia may be said to begin with Peter the Great (1682-1725). In his struggle with Sweden, the dominant power in the Baltic, Peter grasped the relevance to his military campaign of the fact that Sweden was the world's chief producer and exporter of iron, and began what was a veritable Industrial Revolution in Russia. Having connected, by means of canals, the industrial regions of the Ural Mountains with the Baltic and White Seas and with his new capital, St. Petersburg, Peter concentrated on the development of the Uralian iron ore deposits. In 1701 the first two Uralian iron smelting works began the production of cast iron, and in 1702 the first copper smelting works came into action. The result of this rapid metallurgical progress, combined, no doubt, with other favourable factors, was the total defeat of Sweden in 1721. By 1734 the Urals had 32 metallurgical works in full production and in the second half of the 18th century Russia came to occupy first place in the world's production of iron. This industrial progress was accompanied by cultural progress, the chief representative of which was the universal genius, M. V. Lomonosov (1711-1765). As a young man Lomonosov was sent to Germany where he learned the rudiments of mining and mineralogy in Freiberg. In 1757, inspired, no doubt by the Lisbon earthquake of 1755, Lomonosov read a discourse "On the birth of metals from the quaking of the earth." Printed in 1757 in both Russian and Latin, it may claim to be the first Russian published work on geology. It was followed in 1763 by "On the strata of the earth" published as a supplement to Lomonosov's book "Principles of metallurgy and mining." In all his scientific and literary work Lomonosov was assisted by the Academy of Sciences, founded by Peter

[1] Reprint by courtesy of Dr. J. C. Harper, Editor, Liverpool & Manchester Geological Journal (1960, vol. 2, part 3, pp. 474-502).

[2] Sergei Ivanovich Tomkeieff, University of Durham, King's College, Newcastle upon Tyne 1, England. Professor Tomkeieff was born in Russia, Oct. 8, 1892, and was educated at St. Petersburg Polytechnical Institute, studying under Prof. F. Y. Loewinson-Lessing. He has been a resident of Great Britain since 1916 where he studied at King's College, University of London and Manchester University. Since 1920 he has served successively as Lecturer in Geology, Reader in Mineralogy and Professor of Petrology at King's College, New Castle upon the Tyne. He has prepared numerous abstracts, reviews and translations of Russian scientific work in geology and related sciences.

the Great in 1725. He arranged and catalogued the mineral collection of the Academy and projected a plan for the systematic collection of minerals from all parts of the Russian empire. He also inspired and planned several scientific expeditions, which took place only after his death. The one led by Peter Pallas was the most fruitful for geological studies, and the results were published in 1779.

Technical schools attached to mines and smelting works began as far back as 1713, while the first mining institution of higher education, which is now the Mining Institute, was founded in St. Petersburg in 1773. The first Russian Natural History Society was founded in Moscow in 1805 and a Mineralogical Society was founded in St. Petersburg in 1817. Other societies in various towns followed. The first Russian university school was attached originally to the Academy of Sciences, while Universities as such were founded in Moscow in 1755, in Youriev (Dorpat) in 1802, in Vilno in 1803, in Kazan in 1804, in Kharkov in 1805 and in St. Petersburg in 1819.

Since the days of Lomonosov, the progress of geology in Russia has been most spectacular. V. M. Severgin, (1765-1826), the first Russian mineralogist, was followed in the 19th century by a host of mineralogists and geologists, among whom there were at first many foreigners, such as R. I. Murchison, H. Abich and many others. The Geological Committee, the equivalent of the British Geological Survey, was not founded until 1883, largely because Peter the Great's organization of a proper mining survey and establishment of the Government Mining Office (1700), transformed into the Ministry of Mining (1719), made such an institution less necessary. Right through the 19th century the work of geological prospecting and survey, geological research and geological teaching were rapidly progressing and expanding. Sufficient testimony of their progress is the following list of world famous Russian geologists whose lives fit into a period of 165 years:—V. P. Amalitzky (1860-1917), N. I. Andrusov (1861-1924), A. D. Arkhangelsky (1879-1940), D. S. Belyankin (1876-1953), K. S. Bogdanovich (1864-1947), A. A. Borisyak (1872-1944), F. N. Chernyshev (1856-1914), P. A. Chikhachev (1808-1890), V. V. Dokuchaev (1846-1903), E. E. Eichwald (1795-1876), P. V. Eremeev (1830-1899), E. S. Fedorov (1853-1919), A. E. Fersman (1883-1945), A. W. Gadolin (1828-1892), K. D. Glinka (1867-1927), I. M. Gubkin (1871-1939), A. A. Inostrantzev (1843-1919), A. P. Karpinsky (1847-1936), N. I. Koksharov (1818-1892), V. O. Kovalevsky (1842-1883), A. N. Krishtofovich (1885-1953), N. S. Kurnakov (1860-1941), A. E. Lagorio (1852-1925), F. Y. Loewinson-Lessing (1861-1939), I. D. Lukashevich (1863-1928), L. I. Lutugin (1864-1951), I. V. Mushketov (1850-1902), A. V. Nechaev (1864-1915), S. N. Nikitin (1851-1909), V. A. Obruchev (1865-1956), A. P. Pavlov (1854-1929), M. V. Pavlova (1854-1938), C. I. Pander (1794-1865), B. B. Polynov (1877-1952), V. I. Vernadsky (1863-1945), G. V. Wulff (1863-1925), M. D. Zalessky (1877-1946), A. N. Zavaritzky (1884-1952), P. A. Zemyatchinsky (1856-1942).

Organization of Geological Teaching and Research

The three important dates in the 18th century are—1725 the foundation of the Academy of Sciences, 1755 the foundation of Moscow University, and 1773 the foundation of the Mining Institute in St. Petersburg. In 1917 in Russia there existed 14 Universities and 91 other institutions of higher education. According to the latest information in 1956 there are in the U.S.S.R. 37 Universities and 728 other institutions of higher education.

Before 1917 the Academy of Sciences was a very learned and highly esteemed institution, but rather remote from actuality, and a glorified resting place for old age and renown. In the field of geology, the Academy of Sciences supported only the Mineralogical Museum, a remnant of the celebrated "Kunstkamera" founded by Peter the Great. After the revolution of 1917 the Academy of Sciences was completely reorganized, and now it is a vast organization, embracing one central institution and sixteen affiliated regional branches, and over fifty scientific research institutes. In the field of geological sciences the first institute to be organized was the Radium Institute (1922), rapidly followed by the Institute of Applied Mineralogy (1923) now renamed the Institute of Mineral Raw Materials, the Coal Institute (1923), the Lomonosov Institute of Geochemistry and the Petrographical Institute which are now amalgamated, the Palaeontological Institute (1930), and the Geological Institute (1930) which is now subdivided into the Geological Institute as such, the Insti-

tute of the Geology of Ore Deposits, Petrology, Mineralogy and Geochemistry, and the Institute of Mineralogy, Geology and Crystallography of rare elements. These were followed by the Institute of Crystallography (1944), the Institute of Silica Chemistry (1944), the Institute of Geochemistry and Analytical Chemistry (1947) and a number of other institutes, such as the Petroleum Institute, the Institute of Halurgy and the Laboratory of Volcanology. All these institutes are well staffed and have a large number of publications.

The Geological Committee, when it was founded in 1883, was staffed by only eight geologists, and its activity was confined to the geological mapping of parts of European Russia and the Urals. In 1892 its field of activity was greatly enlarged to include not only a detailed mapping of the Donetz Basin Coalfield and Krivoi Rog Ironfield, but also regions along the Trans-Siberian railway, then in the course of construction. In 1912, the staff and the scope of work were again greatly enlarged, so as to include remote regions of the Empire. After the 1917 revolution, the Geological Committee was, like many other institutions, completely reorganized, but due to the civil war its work did not properly begin till 1923. The period 1923-1929 is marked by the publication of large and important memoirs, such as those on the platinum deposits by N. K. Vysotzky, magnetite and copper deposits of the Urals by A. N. Zavaritzky and others. During this period, a number of important discoveries of valuable mineral deposits were made, such as the deposits of apatite and nepheline in the Kola Peninsula, deposits of potash salts in the Solikamsk district and deposits of petroleum in the Volga-Urals region, not to mention countless discoveries of new deposits of iron, copper and other metals.

In 1929 a radical transformation of the Geological Committee took place. It was transformed into the special research institutes, of Geological Maps, Coal, Petroleum, Non-Metallic Deposits, Hydrogeology, Engineering Geology, Geophysics, Ferrous Metals, Non-ferrous Metals and also a Boring Trust. Such departmentalization proved cumbersome, expensive and inefficient and in 1931 all these separate institutes and the Trust were united into a central organization called the Central Scientific-Research Geological Prospecting Institute, a very clumsy title soon abbreviated to Z.N.I.G.R.I., according to the initial letters of its Russian title. In 1938 it was again renamed the All-Union Scientific-Research Geological Institute, this time abbreviated to V.S.E.G.E.I. Such rapid changes necessitated the use of the compound abbreviated title of Z.N.I.G.R.I.-V.S.E.G.E.I. when referring to the past activities of this organization.

Between 1931 and the outbreak of the war Z.N.I.G.R.I.-V.S.E.G.E.I. accomplished an enormous task, mapping and describing various localities, surveying various mineral deposits, working on hydrogeology, engineering geology and on various other problems. During this period important monographs, such as that on serpentine and serpentinites by V. N. Lodochnikov and that on Berdyaush pluton by A. N. Zavaritzky, were published. New methods of survey, geophysical, aeromagnetic, and others were tried with great success. The systematic survey of the territory of the U.S.S.R. revealed a number of important features. Thus a survey of the Pre-Cambrian formations of the Baltic and Ukrainian shields allowed a more detailed stratigraphical subdivision of the metamorphic rocks complex and also the separation of a new Proterozoic system—the Rhiphaean system, apparently equivalent to the Sinian system as developed in China. A systematic establishment of deep stratigraphical boreholes allowed an accurate mapping of the Pre-Cambrian floor of the Russian platform and of the measurement of the thickness of the cover. In the Soviet Carpathians and in the Caucasus there was carried out a detailed study of the petrological, stratigraphical and tectonic relations of the deposits, especially in the petroliferous areas. In the Urals enormous progress was made in stratigraphy, tectonics and in the survey of mineral deposits. The vast territory of Kazakhstan, a hitherto geologically unknown area, was an important field of pure and applied geological research; and so were Central Asia, Pamir and the vast territory of Siberia. A systematic study of the volcanoes of Kamchatka and the Kurile Islands was organized with great success.

During the period 1918-1945 it is estimated that two-thirds (14 millions km^2) of the total territory of the U.S.S.R. was geologically mapped on the scale 1:200,000 and geological maps on the scale of 1:7,500,000 (2 sheets), 1:5,000,000 (8 sheets) and 1:2,500,000 (18 sheets) were published. A substantial work entitled "Geological Structure of U.S.S.R." was published by V.S.E.G.E.I. It is in three volumes: Stratigraphy, Magmatism, Tec-

tonics, and is accompanied by the geological map on the scale 1:7,500,000. A much shorter book dealing with the geology, tectonics and mineral deposits of the U.S.S.R. was published by D. V. Nalivkin. An English translation of this book is to appear in the near future. A "Stratigraphical Dictionary of the U.S.S.R." has also been published.

To co-ordinate the work of geological survey, prospecting and exploitation of the mineral resources, after the war a Ministry of Geology was established. The Ministry, V.S.E.G.E.I., the Institutes of the Academy of Sciences, the Universities and Technical Institutes, and industrial enterprises provide a vast field of employment for trained geologists. According to authorities there are at the present time in the U.S.S.R. 40,000 trained geologists.

Palaeontology

The three aspects of the study of fossils, namely the biological, the stratigraphical, and the sedimentological-facial, are well developed in the U.S.S.R. Palaeontological studies enter into many branches of geology, such as stratigraphy, geological mapping, petroleum survey, sedimentary ore deposits and others. Thus palaeontology is studied not only in the Palaeontological Institute and the Universities but also in the Geological Institute, Petroleum Institute and other research establishments. All these bodies publish palaeontological papers and monographs. The best known are the series "Palaeontology of the U.S.S.R.," "Problems of Palaeontology," and the "Palaeontological Journal" started in 1959. Routine work on the systematics and morphology of fossil plants and animals is carried on. Of special stratigraphical importance are the works published on the Devonian and Pliocene Ostracoda. Special attention is paid to Foraminifera, Bryozoa, corals, Brachiopoda and trilobites. A. V. Martynov, a specialist on fossil insects, is said to have created in the U.S.S.R. the science of Palaeoentomology. A large number of new forms of Palaeozoic Ammonoidea and Nautiloidea have been recorded and phylogenetic assemblages have been constructed. Pelecypoda have been studied by L. S. Davidashvili and others, Archaeocyatha by A. G. Vologdin, Permian insects by G. Zalessky, Bryozoa by M. I. Shulga-Nesterenko. Valuable works on fossil fishes have been published by A. P. Karpinsky and L. S. Berg. The remarkable research started by V. P. Amalitzky on fossil Amphibia and Reptilia has been continued. The study of the ancient primitive forms of quadrupeds by P. P. Shushkin led his successors to discover a new sub-class of Batrachosaura, creatures intermediate between Amphibia and Reptilia. The work on fossil Mammalia was continued by A. A. Borisyak and M. V. Pavlova. A new branch of palaeontology, named "Taphonomia," was established by I. A. Efremov. The aim of this science is to study conditions under which fossil remains of various organisms are preserved as fossils, in other words it is a study of the conditions of fossilization. In 1946-1949 a special palaeontological expedition was organized under the leadership of I. A. Efremov and valuable remains of Mesozoic reptiles and Tertiary mammals were collected in the territory of the Mongolian Peoples Republic. The study of this material has revealed new genera and it is suggested that it may fundamentally alter our views on the distribution of vertebrate animals in Asia during the Mesozoic and the Cainozoic eras.

In the field of palaeobotany, the Palaeozoic flora has been studied by M. D. Zalessky, the Mesozoic flora by A. N. Krishtofovich and V. D. Prinada, the Cainozoic by A. N. Krishtofovich and I. V. Palibin. In several cases it has been possible to establish the climatic zonality of the vegetable organisms during past geological periods. Many palaeobotanical studies have been linked with the study of the lithology and stratigraphy of the coalfields and with the study of the micropetrology of coal. Much work has been done on fossil spores and fossil pollen grains. Important discoveries of spores in the Cambrian and Rhiphaean deposits have been made by S. N. Naumova. Fossil calcareous Algae have been studied by a number of workers including V. P. Maslov.

Stratigraphy

In this field of research one can record the continuation and expansion of the pre-revolutionary work, a series of new discoveries and a gradual filling up of the "blank" areas on the geological maps. The number of publications on stratigraphy is certainly enormous and in this review only a bare outline of progress can be given.

Pre-Cambrian. Great progress has been made in detailed mapping and in subdivision of the Pre-Cambrian rocks in the U.S.S.R. Only a few leading authorities can be mentioned, such as A. A. Polkanov

(Continued on page 45)

ABOVE

Accompanied by Mrs. Weeks, outgoing AAPG President **Lewis Weeks** puts the cares and dignity of office aside for the evening and somewhat bizarrely-attired, heads for the Hawaiian Luau, the main social function of the Atlantic City meeting.

BELOW

Harry Ladd, General Chairman for the Atlantic City Meeting is sketched by the clever caricaturist Sally Zippert in the exhibit booth of the George E. Failing Company.

A REPORT ON THE ATLANTIC CITY AAPG-SEPM MEETING

More than 1600 geologists attended the annual meeting of the American Association of Petroleum Geologists and the Society of Economic Paleontologists and Mineralogists in Atlantic City, April 25-28.

Four pre-convention field excursions to study Appalachian and Coastal Plain geology were very well attended, as were the post-convention Washington research laboratory tours.

One group of papers reviewed the current status of knowledge concerning the petroleum potential of the Eastern United States and Canada, and a symposium session dealt with the expanding petroleum frontiers of the World. There were reports on the Canadian Arctic Islands, South American jungles, the Libyan desert and the remote areas of Western Australia.

The symposium on continental drift and the status report on the mohole project were both well attended. It was an observed fact that attendance at technical sessions was unusually good.

Lewis Weeks in his presidential address drew attention to the mutual responsibility of industry and universities in the present critical employment situation among petroleum geologists.

Highlights of the entertainment agenda for the Atlantic City meeting was the Hawaiian Luau and the post-meeting Washington-staged Pick and Hammer Show depicting in salty satire the politiking of the AAPG (Association for the Advancement of Politics in Geology). The show included in its cast such characters as Glibbly S. Bunkum, Midas Balhooty, Righty Leavensworth, Harry Kidd and Boo Weaks.

SEPM COUNCIL

Left to right—seated: **Gordon Rittenhouse,** Outgoing Past President; **Samuel P. Ellison, Jr.,** Outgoing President; **William M. Furnish Jr.,** Incoming President; Standing: **John Imbrie,** Secretary-Treasurer; **Laurence L. Sloss,** Incoming Vice-President; **William J. Plumley,** Outgoing Vice-President; **Jack L. Hough,** Editor, Journal of Sedimentary Petrology; **M. L. Thompson,** Co.-Editor, Journal of Paleontology; (Absent from picture: **Charles W. Collinson,** Co-Editor, Journal of Paleontology).

NEW AAPG OFFICERS

Left to Right—Seated: **Lewis G. Weeks,** Past President; **Ben H. Parker,** President. Standing: **Frank B. Conselman,** Vice-President; **George V. Cohee,** Secretary-Treasurer; **Grover E. Murray,** Editor.

OUTGOING AAPG OFFICERS

Left to right—seated: **George S. Buchanan,** Past President; **Lewis G. Weeks,** President; standing: **Harold T. Morley,** Secretary-Treasurer; **Grover E. Murray,** Editor; **Alfred H. Bell,** Vice-President.

ATLANTIC CITY MEETING COMMITTEE

Members of the Convention Committee, all members of the Geological Society of Washington, D. C., the sponsoring society of the combined annual meetings of the AAPG-SEPM meeting.

Left to right—seated: **Richard S. Boardman,** of the U. S. National Museum, Vice-Chairman for SEPM; **Harry S. Ladd,** U. S. Geological Survey, General Chairman; **George V. Cohee,** U. S. Geological Survey, General Vice-Chairman. Standing: **Donald H. Dow,** U. S. Geological Survey, Chairman of Finance Committee; **Kenneth E. Lohman,** U. S. Geological Survey, Chairman of Technical Services. (Absent from the picture: **Philip H. Abelson,** Geophysical Laboratory, Washington, D. C., Chairman of the Petroleum Geochemistry Symposium; and **Francis J. Pettijohn,** Johns Hopkins University, Chairman of the Technical Program.)

COMMITTEE OF 1000 VITAL TO AGI

—Now numbers 600—

As of June 1, 1960 the Committee of 1000 for AGI–1960 had grown to 594 members. The contributions of these persons have been extremely important to the Institute. It is not by choice that the American Geological Institute resorts to soliciting contributions from individuals to keep the office door open and the GeoTimes pipeline open in the services of the geological sciences. Unfortunately, there is no provision for assured basic income from the profession beyond the voluntary contributions of member societies.

The nearly 600 members of the Committee of 1000 have each contributed $10 to the AGI in 1960.

Your contribution to the support of GeoTimes and the AGI program is tax-deductible.

RECENT ADDITIONS TO THE COMMITTEE OF 1000 FOR AGI—1960 *

James S. Bailey	J. H. Mackin
G. W. Beer	Richard H. Mahard
Donald L. Bryant	C. R. Maise
Doris M. Curtis	Stuart L. Schoff
Irving S. Fisher	O. A. Seager
George M. Fowler	Roscoe M. Smith
Patrick Arthur Hill	William R. Speer
William H. Holman	Francis A. Stejer
William S. Hopkins, Jr.	Dwight H. Thornburg
Jack W. Knight	Robert J. Weimer
Frederick C. Kruger	George M. Wilson
W. Alex Lorenz	G. Zeschke

* Previous lists published in GeoTimes, March, April and May-June issues.

Limestone Studies At Lehigh

A three-year grant in the amount of $24,225 was recently awarded by the Petroleum Research Fund of the American Chemical Society to Lehigh University for research on the geochemistry of modern carbonate sediments by Dr. Keith E. Chave, assistant professor of geology.

The project, investigation of the durability and stability of marine skeletal carbonates in various natural environments," is expected to contribute significantly to the geologic understanding of the origin and history of limestone.

AGI Visiting International Scientist Program

Six internationally-known scientists participated in the first AGI Visiting International Scientist Program sponsored during the past academic year by the Institute, aided by a grant from the National Science Foundation. Professor Paul G. K. Ramdohr, University of Heidelberg; Professor Augustin Lombard, University of Geneva; and Dr. Stevenson Buchan, Assistant Director, Geological Survey of Great Britain came to the United States especially to participate in the program. Each of these scientists made scheduled visits to eight graduate departments of geology and came into contact with numerous other geologists during their 3-month visits.

Also participating in the program were three foreign scientists already in this country. These were T. J. van Andel (Groningen) now at Scripps, who made four visits; Professor Douglas Coombs, (University of Otago, Dunedin, New Zealand), now at Pennsylvania State University, made two visits; and Professor S. Warren S. Carey, (University of Tasmania) now at Yale, made one visit.

New Kentucky Mapping Project

In July 1960 the state of Kentucky is launching in cooperation with the U. S. Geological Survey a 10-year, $12 million, geologic mapping program which has as its objective state-wide coverage by 7½ minute quadrangle geologic maps. The program is the first state-federal cooperative program of such magnitude for geologic mapping.

The project will involve the preparation of 750 detailed maps at the scale 1:24,000. Cost of the program will be shared jointly by the state and federal governments on a matching fund basis. The Kentucky legislature appropriated $300,000 for the first year of operation, to be matched by a similar amount in federal funds. In the second year, the program will be stepped up to a $1.2 million level.

The program has been developed by Dr. Wallace H. Hagen, State Geologist of Kentucky in cooperation with the U. S. Geological Survey. The mapping will be carried by the U.S.G.S. in a manner similar to the cooperative topographic mapping and ground water resources programs. A recently completed cooperative topographic mapping program will provide up-to-date topographic base maps for the geologic mapping.

Geology in Conservation Theme at National Boy Scout Jamboree

Conservation will be the central theme of the National Jamboree of the Boy Scouts of America which will be staged near the Air Force Academy at Colorado Springs, July 22-28.

In the center of the jamboree site will be the conservation area through which most of the 60,000 scouts and leaders attending the jamboree will pass during the 7-day period. The scouts will travel through four major exhibit areas: 1) Fish and Game, 2) Forest and Range, 3) Soil and Water, and 4) Geology and Weather. All four of these areas exit into a central "Bull Pen."

In the Geology and Weather Area there will be nine "stations" or separate exhibit areas. The one on weather is being provided by the U. S. Weather Bureau and the archeological station is provided by the Denver Museum. The topographic map station and the six geology exhibits are prepared by the U. S. Geological Survey, Denver.

The central "Bull Pen" will be a scout participation area where there will be conservation oriented games of skill and operating exhibits. Scouts entering this area will be able to try their hand at uranium prospecting, watch a drill rig in operation, and assemble a collection of minerals to take home as a souvenir.

The geology exhibit area will be manned by professional geologists and a corps of specially-trained explorer scouts.

Mineral specimens for the collections to be assembled by scouts are being contributed by the following:

Colorado Fuel & Iron Co. (iron ore)
Kennecott Copper Corp. (copper ore)
Climax Molybdenum Co. (molybdenum ore)
American Gilsonite Co. (gilsonite)
U. S. Bureau of Mines (oil shale)

A booklet describing the geologic significance of the minerals in the collection is being supplied by the Williams & Heintz Lithograph Division, Kauffmann Press, printers of GeoTimes. A grant from the American Petroleum Institute has been made to defray the costs of plastic sample bags and other exhibit operating expenses.

The over-all geology jamboree project is under the direction of Gerald M. Richmond of the U. S. Geological Survey, Denver, and involves the cooperation of the Rocky Mountain Association of Geologists, the Colorado Scientific Society, Colorado College and the American Association of Petroleum Geologists in addition to the aforementioned organizations and companies. Chalmer L. Cooper, Chairman of the AGI Boy Scout Committee, has served in planning and liaison with the executives of the BSA National Council.

Fakultät Für Bergbau Und Hüttenwesen T U Berlin. Pictured above is the new building of the Faculty of Mining and Metallurgy of the Technical University of Berlin. The Mining Academy of Berlin, forerunner of the present day Institute, was founded in 1770 by Frederic the Great. The faculty in the mining section includes Professors Strunz (mineralogy), Simon (geology), Donath (economic geology), Hosemann (mining), Hilbig (underground surveying) and Grunder (ore dressing). This section now has about 350 students. There is in addition, a metallurgy section with five professors and about 250 students.

Over its long history the Institute has had among its famous professors in mining and mineralogy Gerhard, Karsten, Christian Samuel Weib, Gustav Rose, v. Dechen, v. Carnall u.a., in geology Beyrich, Hauchecorne, Beyschlag, Krusch, in chemistry Klaproth, who in 1789 discovered uranium, Rammelsberg and Pufahl, the discoverer of Germanit.

ORGANIC GEOCHEMICAL RESEARCH

A report by Bartholomew Nagy, Chairman, Organic Geochemistry Group, the Geochemical Society

The Organic Geochemistry Group of The Geochemical Society was organized at the Pittsburgh meeting of the Society in November 1959. Members of the Executive Committee for the group are: Philip H. Abelson, E. G. Baker, I. A. Breger, W. E. Hanson, Earl Ingerson, Paul A. Witherspoon and Bartholomew Nagy, *Chairman*. Affiliation in the Organic Geochemical Group is open to all members of the Geochemical Society at no additional membership cost and society members seeking affiliation should contact Chairman Nagy.

The purpose of the group is to encourage and foster studies on the origin, nature, geochemical significance and behavior during diagenesis of naturally occurring organic substances that relate to their geological occurrence and history. It is believed that this purpose can best be achieved through the cooperative efforts of organic chemists working with geologists and other earth scientists. The next annual meeting of The Geochemical Society will be held in Denver, Colorado, during October 31, November 1 and 2, 1960. The program will include contributions in organic geochemistry.

Organic geochemistry deals with the nature and origin of naturally occurring organic substances. It includes the organic chemistry of soils and recent sediments, coal and petroleum geochemistry, paleobiochemistry, certain aspects of bacteriology, oceanography, and clay-mineralogy, etc. Organic geochemistry keeps attracting the research efforts of an increasing number of earth scientists. There are numerous unsolved problems in this field, many of which call for creative ideas and for the accumulation of basic data.

The Geochemical Society was founded in 1955 to encourage the application of chemistry to the solution of geological and cosmological problems. Membership is international; annual dues are $2 and members are entitled to receive the journal *Geochemica et Cosmochimica Acta* at a special subscription price of $10 per year. Persons interested in membership should address inquiries to *Secretary Konrad B. Krauskopf, Dept. of Geology, Stanford University, California.*

Listed here are known active research projects in organic geochemistry compiled by the Executive Committee of the Organic Geochemistry Group. It is recognized that this may be incomplete. Members of the Geochemical Society wishing to be identified with the Group, or persons wishing to submit additional names of institutions engaged in organic geochemical research are invited to communicate with *Professor Bartholomew Nagy, Dept. of Chemistry, Fordham University, New York 58, N. Y.*

GEOCHEMICAL SESSIONS

Scheduled for Helsinki, IUGG

Monday, July 25

A.M. Symposium on Geochemistry—Isotope Geology

P.M. Symposium on Geochemistry—Experimental and Theoretical Petrology

Tuesday, July 26

P.M. First meeting to discuss role of geochemistry in international meetings (open session)

Wednesday, July 27

A.M.-P.M. Symposium on Age Determinations

Thursday, July 28

A.M. Second discussion meeting

SCHEDULED FOR COPENHAGEN

(not listed in IGC printed program)

Wednesday, August 17

Geochemical Reference Standards, sponsored by the Geochemical Society and organized by the Committee on Standards

Thursday and Friday
August 18 and 19

Geochemistry of Sedimentary Carbonate Rocks, sponsored by the Commission of Geochemistry of the International Union of Pure and Applied Chemistry

CURRENT ORGANIC GEOCHEMISTRY RESEARCH

Institution	Research in Progress
Research Council of Alberta Edmonton, Alberta, Canada	A2, B1
University of California Berkeley, Cal.	C1
California Research Corp. La Habra, Cal.	A7, C2
Cornell University Ithaca, New York	A2
Esso Research and Engineering Co. Linden, New Jersey	A2, C1, C2
University of Exeter England	C1
Florida State University Tallahassee, Florida	A1
Fordham University New York, N. Y.	A8, C1, C3
French Institute of Petroleum Paris, France	A2, C1
Geophysical Laboratory (Carnegie) Washington, D. C.	A1, A7
Gulf Research and Development Co. Harmarville, Pa.	C2
Imperial College of Science and Technology London, England	A6
University of Illinois Urbana, Ill.	A6, B3
Jersey Production Research Co. Tulsa, Okla.	A2, A7
Sir John Cass College England	C1
Johns Hopkins University Baltimore, Md.	C1
Mellon Institute Gulf R & D Fellowship Pittsburgh, Pa.	A5, C1
University of Minnesota Minneapolis, Minn.	A6
Mobil Oil Co. Field Research Laboratory Dallas, Texas	A2, C1
Montecatini Novara, Italy	C1
Ohio Oil Co. Denver, Colo.	C2
Ohio State University Columbus, Ohio	B3
University of Oklahoma Norman, Okla.	C2
Pan American Petroleum Corp. Tulsa, Okla.	C2
Petroleum Research Corp. Denver, Colo.	C2
Pure Oil Co. Crystal Lake, Ill.	C2
Shell Development Co. Houston, Texas	C1, C2
Royal Dutch Shell Amsterdam, Holland	A2
Scripps Institution of Oceanography La Jolla, Cal.	A1, A2, A7
University of Texas Austin, Texas	C1
University of Texas Port Aransas, Texas	A3
Texas A. & M. College College Station, Texas	A4
U. S. Bureau of Mines Pittsburgh, Pa.	B2
U. S. Bureau of Mines Bartlesville, Okla. Laramie, Wyo.	C1
U. S. Geological Survey Washington, D. C.	A6, B1
Woods Hole Oceanographic Institution Woods Hole, Mass.	A2

Key Research Projects in Progress

A. *Fundamentals of Organic Geochemistry*
- A1. *Paleobiochemistry*
- A2. *Geochemistry of Recent Sediments*
- A3. *Bacteriology of Recent Sediments*
- A4. *Geochemistry of Recent Sediments and Sea Water*
- A5. *Organic Geochemistry of Recent Sediments and of Sedimentary Rocks*
- A6. *Organic Geochemistry of Sedimentary Rocks*
- A7. *Isotope (organic) Geochemistry*
- A8. *Chemical Aspects of Fluid Flow in Rocks*

B. *Coal and Soil Organic Geochemistry*
- B1 *Organic Geochemistry of Coal*
- B2. *Microbiology of Coal*
- B3. *Organic Geochemistry of Soils*

C. *Petroleum Geochemistry*
- C1. *Crude Oil Composition*
- C2. *Petroleum Migration and Accumulation*
- C3. *Hydrocarbon Phase Equilibria*

HISTORY OF THE INTERNATIONAL GEOLOGICAL CONGRESS

Geologists from all points of the compass will converge on the Nordic countries for the XXIst International Geological Congress which will convene in Copenhagen on August 15. The Congress will be in session until August 25.

Pre-Congress excursions start in early August and post-Congress excursions will last until mid-September.

It may be of interest to geologists to know that the International Geological Congress is the oldest international scientific congress in existence, and that American geologists were primarily responsible for its birth. The need for an international organization to pass with authority on questions of classification and geologic nomenclature was keenly felt by a number of American geologists in the early 1870's, and after several informal discussions in 1875 the desirability of organizing an international geological congress was called to the attention of the American Association for the Advancement of Science in 1876 at its annual meeting in Buffalo, New York. The general plan for organizing an international congress was approved and the founding committee was appointed with James Hall its president, and T. Sterry Hunt its secretary; the other members included: J. S. Newberry, Rafael Pumpelly, J. W. Dawson, C. H. Hitchcock, W. B. Rogers; T. H. Huxley (Great Britain), Otto Torell (Sweden), and E. H. de Baumhauer (Netherlands). A circular letter prepared in English, French, and German was sent to leading geologists of many countries asking them to attend the first International Geological Congress meeting which was held in Paris during the 1878 International Exposition. The success of the first congress was so clear-cut and the need for the organization so evident that it has continued to convene about once in four years ever since the original meeting in Paris. Although it has no permanent organization and is dependent for its continuity on invitations received from delegates of some country during a meeting, it has functioned amazingly well.

Quite commonly an individual congress will take some geologic theme of international significance and call together specialists from all over the world to contribute their theories, facts, or points of view toward the solution of a worldwide problem. In addition to settling problems of geologic nomenclature and geologic classification, several of the congresses have stressed certain mineral resources and obtained the first worldwide appraisals of any real significance. The Canadian sessions held in 1910 resulted in the first appraisal of the coal resources of the world and following that excellent example, similar world-wide resource studies have been made on iron, copper, lead and zinc, as well as many other important subjects of less economic significance. The scientific sessions generally last about a week and are of great interest to most of the participants, but the field excursions that usually precede and follow the scientific sessions, are as much of a drawing card as the scientific sessions themselves. These excursions have ranged in duration from one day to three weeks.

There have been in all twenty sessions which were held at the following times and places:

1.	1878	FRANCE
2.	1881	ITALY
3.	1885	GERMANY
4.	1888	GREAT BRITAIN
5.	1891	UNITED STATES OF AMERICA
6.	1894	SWITZERLAND
7.	1897	RUSSIA
8.	1900	FRANCE
9.	1903	AUSTRIA
10.	1906	MEXICO
11.	1910	SWEDEN
12.	1913	CANADA
13.	1922	BELGIUM
14.	1926	SPAIN
15.	1929	UNION OF SOUTH AFRICA
16.	1933	UNITED STATES OF AMERICA
17.	1937	UNION OF SOVIET SOCIALIST REP.
18.	1948	GREAT BRITAIN
19.	1952	ALGERIA
20.	1956	MEXICO

The host countries to the XXIst International Geological Congress will be the five Nordic nations: Norway, Sweden, Iceland, Finland and Denmark.

His Majesty King Frederik IX of Denmark has honored the Congress with his patronage and the following ministers of the host countries will serve on the Honorary Committee of the Congress: DENMARK: Jorgen Jorgensen, Minister of Education, Kai Lindberg, Minister of Public Works. FINLAND: V. J. Sukselainen, Prime Minister, Ahti Karjalainen, Minister of Commerce and Industry. ICELAND:Gylfi Gislason, Minister of Culture, Ingolfur Jonsson, Minister of Agriculture. NORWAY: Halvard Lange, Minister for Foreign Affairs, Birger Bergersen, Minister of Church and Education. SWEDEN: Gunnar Lange, Minister of Commerce, Ragnar Edenman, Minister of Educational and Ecclesiastical Affairs.

THE GEOLOGICAL SURVEYS OF THE WORLD

- AGI Data Sheet 14, Revised June 1960 -

AGI 14

fold here

This data sheet was published originally in the September 1959 issue of GeoTimes. In preparing is revision, all known geological surveys of the world were contacted for additions and corrections. tate and provincial surveys are not included. Information on further additions or corrections hould be sent to the American Geological Institute.

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601 Booth Street
Ottawa

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Østervoldgade 7
København K, Danmark

MEXICO
Instituto de Geologia
Universidad Nacional Autónoma de México
Ciudad Universitaria
Mexico 20, D. F.

UNITED STATES
U. S. Geological Survey
Washington 25, D. C.

CENTRAL AMERICA AND CARIBBEAN ISLANDS

COSTA RICA
Departamento de Geologia
Ciudad Universitaria
San José

CUBA
Instituto Nacional de Investigaciones
Cientificas, Cerro 827,
Havana

DOMINICAN REPUBLIC
Secretaria de Estado de Fomento
Direccion de Mineria
Ciudad Trujillo

EL SALVADOR
Servicio Géologico Nacional
23 Avenida Norte No. 140
San Salvador

GUATEMALA
Sección de Geología
Dirección General de Minería e Hidrocarburos
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HAITI
Geological Survey
Department of Agriculture
Damiens près Port-au-Prince

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NICARAGUA
Servicio Geologico Nacional
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Ministerio de Minas e Hidrocarburos
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FINLAND
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GREAT BRITAIN
Geological Survey & Museum
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Ministry of Industry
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LIECHTENSTEIN
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LUXEMBOURG
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NETHERLANDS
Geological Survey
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Josefines gate 34, Oslo

POLAND
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SWITZERLAND
Geologische Kommission der Schweizerische Naturforschende Gesellschaft
Basel Bernoullianum

UNION OF SOVIET SOCIALIST REPUBLICS
Ministry of Geology
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Additional copies of this data sheet may be obtained from the AMERICAN GEOLOGICAL INSTITUTE, Cost $0.10.

Data Sheet 14 Revised

Presented here is a revision of AGI Data Sheet 14, *The Geological Surveys of the World,* which first appeared in the September 1959 issue of GeoTimes. Readers of GeoTimes called to the attention of the Editor and the Data Sheet Committee numerous corrections and errors of omissions which have been incorporated in this revision. In preparing the revision the geological surveys of the world were contacted to verify proper names and addresses of the organizations. No attempt has been made to list state and provincial surveys.

The Data Sheet Committee is composed of John E. Allen, William Beatty, Chester Longwell, Vincent McKelvey, George Thompson, Ian Campbell and Richard M. Foose, Chairman. Suggestions for data sheets should be sent to *Dr. R. M. Foose, Earth Science Division, Stanford Research Institute, Menlo Park, Calif.*

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PACIFIC SCIENCE CONFERENCE

August 21 - September 6

The Tenth Pacific Science Congress of the Pacific Science Association will be held at the University of Hawaii, Honolulu, from 21 August to 6 September 1961, sponsored by the National Academy of Sciences, Washington, D. C. and the Bernice P. Bishop Museum, with the cooperation of the University. Scientific sessions will be held from 21 August to 2 September, with a post-sessional field trip through 6 September.

Dr. Laurence H. Snyder, President of the University of Hawaii, is President of the Congress, and Mr. Harold J. Coolidge, Executive Director of the Pacific Science Board of the National Academy of Sciences, is Secretary-General. Nine Sections of the Congress are planning symposia for their main meetings, but provision is also being made for sessions of grouped papers and sessions of contributed papers.

The program for the Section of Geophysical Sciences is under the direction of Dr. Lloyd V. Berkner, President of Associated Universities, Inc. This Section is divided into three Divisions, and organizers for the programs are Dr. C. E. Palmer of the Institute of Geophysics at the University of California at Los Angeles and Dr. Colin S. Ramage of the Hawaii Institute of Geophysics at the University of Hawaii for the Division of Meteorology and Upper Atmosphere; Dr. Walter H. Munk of Scripps Institution at the University of California and Dr. Thomas S. Austin of the U. S. Fish and Wildlife Service in Honolulu for the Division of Oceanography; and Dr. Gordon A. Macdonald of the Hawaii Institute of Geophysics at the University of Hawaii for the Division of Solid Earth Sciences.

The planned program to date includes a number of symposia of which the following will be of direct or indirect interest to geologists.

The Matthew Fontaine Maury Memorial Symposium for Antarctic Research

Convener: Dr. Harry Wexler, U. S. Weather Bureau, Washington, D. C., USA

Tsunamis

Convener: Dr. W. G. Van Dorn, Scripps Institution of Oceanography, University of California, La Jolla, California, USA

Equatorial Circulation in the Pacific

Convener: Dr. John A. Knauss, Scripps Institution of Oceanography, University of California, La Jolla, California, USA

Deep Circulation in the Pacific

Convener: Dr. J. C. Swallow, National Institute of Oceanography, Surrey, England

North Pacific Circulation

Convener: Dr. John P. Tully, Pacific Biological Station, Nanaimo, British Columbia, Canada

Recent Advances in Oceanography Instrumentation

Convener: Dr. D. J. Rochford, Commonwealth Scientific and Industrial Research Organization Laboratory, Sydney, Australia

Radioactive Tracers in Oceanography

Convener: Dr. Y. Miyake, Meteorological Research Institute, Tokyo, Japan

The Topography and Sediments of the Pacific

Convener: Dr. E. L. Hamilton, U. S. Navy Electronics Laboratory, San Diego, California, USA

The Earth's Crust in the Pacific Basin

Convener: Dr. E. I. Robertson, Department of Scientific and Industrial Research, Wellington, New Zealand

Volcanism and Plutonism in Relation to Types of Crustal Deformation

Convener: Dr. Hisashi Kuno, Geological Institute, Tokoyo University, Tokyo, Japan

Pacific Island Terraces—Eustatic?

Convener: Dr. Richard J. Russell, Louisiana State University, Baton Rouge, Louisiana, USA

The Congress Circular of Information with detail on program, field trips, and other matters, will be issued in August 1960. Inquiries for the Circular and other Congress information should be addressed to *Secretary-General, Tenth Pacific Science Congress, Bishop Museum, Honolulu 17, Hawaii, USA.*

GEOLOGY in the Public Eye

by
Robert L. Bates
Department of Geology, Ohio State University

The March column about the COST project elicited this from a geologist who doesn't want to be identified by name, employer, or even section of the country: "*Congratulations . . . I fear that our profession is rapidly splitting into two divisions: the geologists and the grantologists. The grantologist spends most of his time writing up proposals, seeking out Big Money, contracting for hordes of graduate students to man his projects . . . and writing 'progress' reports as exercises in super-flattery to keep the money rolling in.*" We don't know whether the term *grantologist* is original with this correspondent, but it's very handy and we're adding it to our working vocabulary.

The geology students at Baylor University have conducted their fourth annual field trip, a one-day 32-mile excursion in McLennan County, Texas. This is news because the trip was advertised on radio and TV and in the papers, and a large number of towns-people attended. In fact, 350 people in 94 cars is quite a group, and the 35-page illustrated guidebook is a credit to the students who planned and carried on the whole operation. O. T. Hayward states that the Baylor students "conduct much better organized field trips than do professional societies." . . . Circular 7 of the Indiana Survey is an 83-page illustrated booklet by T. G. Perry on fossils, for student, teacher, and layman; and the Florida Survey has issued "*Fossil Mammals of Florida,*" a 74-page booklet by S. J. Olsen with figures and maps. Nice jobs, both of them. . . . Virginia's Division of Mineral Resources has distributed 1000 rock-and-mineral sets to secondary schools in the Old Dominion. Presentation of the first set to Governor Almond was televised, and reported widely in the press. The collection consists of 25 large specimens, handsomely boxed, with a map of the state on the inside cover and an explanatory leaflet. . . . Down at VPI, Dick Dietrich's pamphlet "*Virginia Minerals and Rocks*" has gone into a third edition, bringing the total number of copies in print to over 12,000. . . . These projects all show what non-grantologists can do when not burdened with a budget of several million dollars.

Danish Oceanographer Awarded Agassiz Medal

The outstanding Danish oceanographer, Dr. Anton Frederick Bruun of the University of Copenhagen was recently awarded the Alexander Agassiz Gold Medal of the National Academy of Sciences-National Research Council of the United States for his original contributions to oceanography and his effective leadership of oceanographic expeditions. Outstanding among his accomplishments was his leadership of the 1950-52 globe-circling Galathea expedition. In this expedition he was able to enlist scientists of many nations in the cooperative research program.

Dr. Bruun was born in Jelling, the ancient Viking capital of Jutland. He earned his doctorate at the University of Copenhagen in 1935. From 1926 until 1933 he was engaged in oceanographic research as a member of the Danish Fisheries Commission and in 1933 became associated with the University's Zoological Museum. He also has held appointments at the Carlsberg Laboratory, the Danish Aquarium and the Marine Biological Laboratory. He is currently directing an expedition to the South China Sea, sponsored jointly by the Scripps Institution of Oceanography and the International Cooperation Administration.

To A Geologist

Earth wears a mantle rich with lore,
  Of storied fabric finely spun,
That tells of kingdoms come and gone,
  Of legions lost and battles won.
Not seer nor monarch can divine
  The cryptic writings; he alone,
Who humbly speaks the tongue of earth,
  Can wrest a story from a stone.

Edwin B. Matzke

reprinted from New York Times, Sunday, October 4, 1942

INDIAN OCEAN EXPLORATION

Over a dozen nations of the World are pooling their research talents to explore the Indian Ocean, one of the last unexplored frontiers of the world. The Indian Ocean research effort is being developed by SCOR (Special Committee on Oceanographic Research) under the non-governmental sponsorship of ICSU (the International Council of Scientific Unions).

Preliminary plans for the concerted research assault on the Indian Ocean will be reviewed at SCOR meetings in Copenhagen, July 9-10, 1960 and finalized by August 1960. The peak of the activity will occur in 1962-63 and will continue at least into 1964.

Problems will be studied in the areas of physical oceanography, chemical oceanography, meteorology, marine biology and marine geology-geophysics.

It is expected that sounding data will afford much greater delineation of ocean bottom topography. Intensive coring, dredging and bottom photography will contribute new data on the geology of the Indian Ocean floor and possibly shed light on potential mineral resources. Integrated geophysical studies will provide heat flow data, gravity and magnetic information, and data on the thickness of the crust.

Expedition Monsoon conducted by an oceanographic research vessel of the Scripps Institute of Oceanography and the University of California will reconnoiter the southern and central Indian Ocean during the period August 1960-February 1961 in advance of the SCOR-sponsored International Indian Ocean Expedition. Observations are expected to be carried out along 35,000 miles of ocean traverse. Robert L. Fisher will coordinate the overall Monsoon scientific program which will include geological-geochemical-geophysical research. George Shor, Tj. H. van Andel and Henry W. Menard will supervise various geographic segments of the program.

The United States will contribute 4 and ½ ship-years out of a total of 15 to the program in seven scheduled oceanographic cruises. The program will require $6.5 million which will be solicited from governments, international agencies and private foundations.

Coordinator for the International Indian Ocean Expedition is Robert G. Snider. Offices for the expedition are at 30 E. 40th St., New York 16, N. Y.

Significant Discovery by U. S. G. S.

Coesite found at Meteor Crater

An important new mineral discovery by Dr. Edward C. T. Chao of the U. S. Geological Survey has interesting and far-reaching implications in geochemistry and "space geology."

In a detailed mineralogical study of highly sheared sandstones collected by Dr. Eugene M. Shoemaker, also of the U. S. G. S., Chao discovered abundant *Coesite,* a dense, high temperature form of SiO_2 not previously known to occur naturally on earth.

Coesite was first produced in 1953 in the laboratory of the Norton Co. and more recently by F. T. Boyd and J. L. England of the Geophysical Laboratory who stated that "Quartz could not invert to coesite in the earth at depths of less than 100 km." The temperature-pressure range necessary for the formation of coesite is comparable to that required for the formation of diamond. Recognition of coesite as a product probably of impact at Meteor Crater provides significant new data in the study of space geology high temperature-pressure relationships within the earth itself.

In September, GeoTimes will carry an interesting account by Survey staff members of the coesite discovery.

Drilling and Blasting Conference

Colo. School of Mines
October 17-19

The Colorado School of Mines will be host at Golden, Colorado, October 17-19, to the Biannual Symposium on Drilling and Blasting sponsored by the mining departments of the University of Minnesota, Pennsylvania State University and the Colorado School of Mines. The program will include papers of interest in both basic and applied research. More information may be obtained by writing *L. J. Parkinson, Chairman, Organizing Committee, c/o Colorado School of Mines, Golden, Colo.*

MANPOWER *in a column —*

By HOWARD A. MEYERHOFF
Scientific Manpower Commission
1507 M Street, N.W., Washington 5, D. C.

The Scientific Manpower Commission keeps close watch over the employment outlook in all fields of science, but does not, and cannot, provide placement service. Yet stray requests come for placement help, most of them from geologists. The most we can offer is advice—and, under present circumstances, not much of that.

The assortment currently on hand bears analysis. The ages range from 23 to 59, and experience from zero to 35 years. Hardest hit and numerically largest in the over-age group (40 and older) are consultants. Obviously, the consulting business "ain't so good." None of the group has ever worked for the Federal government, nor has any of them taught. Only one has a Ph.D.

Advice is reputed to be cheap, but serious effort should be made to give it value. The advice given is repeated here for what it's worth to others who are looking for their next pay check.

Exploration has not ceased, and one idea is to be underfoot where things are about to happen. A careful watch for company activities reveals impending exploratory plans. Announcements of projects generally reach the oil and mining journals late, but not always too late. Grants of concessions in Africa, Latin America, or elsewhere may mean new projects must be staffed. Advertisements for bids on dams, roads, and other public works at home or abroad could mean jobs in geological engineering with the successful bidder.

Mining and mining geology are no longer the preserve of mining companies. Manufacturers of inorganic chemicals are six levels deep in the extraction of mineral raw materials. True, some of them are vague about the function of geologists, but if the applicant for a job can point to a minor in chemistry, it will help influence chemists and win jobs.

High school teaching of general science is a shortage field that may offer a temporary haven—and a more lasting one if certification requirements are met.

We've run out of space before we've run out of ideas. Just one last thought: The best hunting is in peripheral fields where most geologists do not think to look and where prospective employers didn't realize they were looking for geologists.

Montana Earthquake Area To Be Visited by Billings Society

The Eleventh Annual Field Conference of the Billings Geological Society will be held in the Hebgen Lake–Madison Valley of southwestern Montana during September 7-10, 1960. Registration is scheduled for the afternoon of September 7 in West Yellowstone. On September 8 the group will spend the day studying the phenomena of the August 1959 earthquake in the vicinity of Hebgen Lake. The following day will be spent in traversing the area between West Yellowstone to the slide area via Reynolds Pass. On the final day the group will cross the Gravelly Range to Ennis and into the Jack Creek area.

Reservations and housing application forms may be obtained by writing *Richard L. Jodry, P. O. Box 219, Billings, Montana.*

Belgian Conference on Silica and Glasses

The Belgian Association for the Study of Glasses and Siliceous Compounds has announced the program of international study meetings to be held in September and October of this year. The program will offer: "A colloquium on silica" to take place in Brussels at the end of September; a second colloquium on "The utilization of electrochemical methods at high temperature, their application to the prediction of reactions and to the study of the behavior of materials" to be held at the University of Brussels at the beginning of October; a day of study on "Minerals, agglomerates and refractory materials" at Charleroi the latter part of September; and a period of meetings devoted to the study of hydraulic binders and their employment, to be held in Brussels during the last fortnight of September. Further information regarding the meetings may be obtained by writing to the Association at the *Secretariat, 13, Rue des Poissonniers, Bruxelles 1, Belgique.*

WILMOT H. BRADLEY HONORED

Bill Bradley, Geologist
Administrator Bon Vivant,
Raconteur Extraordinaire

A special bouquet goes to the American Journal of Science for its recently issued *Bradley Volume* (vol. 285-A) paying tribute to Wilmot H. Bradley who in 1959 completed a 15-year tour of duty as Chief Geologist, U. S. Geological Survey and assumed new duties as Research Geologist. A collection of 38 papers on widely varying subjects in geology and related subjects have been contributed to this Festschrift by Bill Bradley's friends and associates.

Dr. Bradley is widely known for his geologic research on the Green River Formation of Colorado and Utah which has continued since graduate school days at Yale. He is a member of the National Academy of Sciences and has received numerous honors in recognition of his geologic research and achievements as a science administrator. For a period of 15 years he has served as an Associate Editor of the American Journal of Science.

W. P. Woodring keynotes the Bradley Volume with a very fine biography, but survey associates point out certain facets of this which did not come to light in this exposition.

Among other stories called to mind was the story of Bradley as an actor in the famed Pick and Hammer Show. His most famous role was a take-off on the late N. L. Bowen, who was addicted to the use of latin phrases. In satire of Bowen, Bill spoke entirely in Latin and yet managed to convey the sense of his remarks by means of Bowen-like gestures. On another occasion Bill, teamed up with another Yale graduate, formed the head end of a stage horse. At a critical stage of discussion of the "Yaleness" of things on the survey, the aft end of said horse gave forth with a muffled pithy—"I am a Yale man myself!"

Bradley is also widely known as an accomplished teller-of-tales. It is a survey canard that ability to tell and listen to folk tales was a requisite of all branch chiefs serving under him.

Speaking of Dr. Bradley's days as Chief Geologist, biographer Woodring has written as follows:

"Bradley will long be remembered for his 15-year tour of duty as Chief Geologist. When he came to Washington in 1922, the Geologic Division had some 120 geologists and other professional employees, but when he became Chief Geologist that number had risen to some 400 and it reached a maximum of almost 1,000 in 1955. It was his responsibility to plan and direct, through his Branch Chiefs, the research activities of that large staff. During his tenure of office new vistas in geology were unfolding. He had the foresight to see and anticipate them and the good judgment to explore and expand them. His greatest satisfaction came from seeing new frontiers occupied and bearing fruit, his greatest frustration from the realization that his plans could not be fulfilled on account of the lack of personnel or funds. He inspired loyalty, not only in his Assistant Chief Geologists and Branch Chiefs, with whom he was in closest contact, but throughout the Geologic Division. He enjoyed dealing with people and his relations with them were tempered with his innate modesty and the milk of human kindness, although he could be tough when the rare occasion demanded it."

SIR,

You might be interested to receive an answer to your geologic Quiz No. 2, published on the outside back cover of Vol. IV, No. 6 of your magazine, from way down here in South Africa. My answer is that the area shown covers the southern part of Death Valley in California.

Yours sincerely,

DR. A. S. BRINK
University of Witwatersrand

DEAR SIRS:

Enclosed are the completed *National Register* and *GeoTimes* forms for the six senior majors in geology at Cornell College, Mt. Vernon, Iowa.

Your policy of sending *GeoTimes* for a limited time to graduating seniors and graduate students is a very wise one. I hope you will continue to make this offer as an inducement to complete the *Earth Science Register* questionnaire.

Thank you very much.

Sincerely,

HERBERT E. HENDRIKS
Cornell College
Mount Vernon, Iowa

DEAR EDITOR:

Thank you very much for your cooperation in calling your readers' attention to our forthcoming Field Trip. We feel sure that the notice on page 32 of the April issue of *GeoTimes* will reach many who would like to participate in the Field Trip but who would have had no other means of obtaining the pertinent information. We appreciate your assistance in publicizing our trip.

Very truly yours,

W. D. REVES
Southeastern Geological Society

DEAR EDITOR:

No sooner did the January-February issue of GeoTimes hit our Region 2 Office in Omaha than we got a letter pointing out the geologists who helped the National Park Service through the AGI Mission 66 Program aren't the only ones by a long shot!

Charles Robinson helped prepare an exhibit plan and Stanley Lohman is doing similar work at Colorado. Gerry Richmond is advising the Rocky Mountain staff on glaciation and tundra while Wally Hansen explains the geology of Black Canyon of the Gunnison. Ed McKee, Steve Oriel, and Ed Lewis have given us lots of help in paleontological matters.

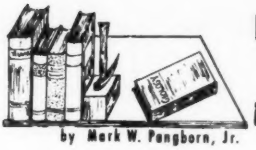
These fellows all work for the USGS in Denver. We feel they too deserve a tip of the AGI Mission 66 Committee hat for professional services rendered. Don't you?

Sincerely yours,

JOHN M. GOOD
Geologist, National Park Service

LETTERS TO THE EDITOR

Letters should be kept brief, 200 words or less and must be signed.



Popular Geology in print

by Mark W. Pangborn, Jr.

Now that geology is straining hard at its traces, and looking toward other worlds, we might examine some recent laymen's literature on our solar system.

British astronomer *V. A. Firsoff's* STRANGE WORLD OF THE MOON (Basic Books, 1959, $6) is an expert, semi-popular compendium of data on the moon, its origin, surface, and possible life, that will please both serious layman and scientist, a meaty book which requires some knowledge of geology to appreciate fully; the mathematical treatment is wisely grouped in an appendix; good illustrations and bibliographies.

Just the thing for older children and the uninitiated adult is *Otto Binder's* THE MOON, OUR NEIGHBORING WORLD (Golden Press, 1959, $.50); like many other volumes in the "Golden library of knowledge" series. this brief primer is loaded with fine pictures, mainly in color, which are nicely integrated with a simply-written informative text. For the same audience is physicist *George Gamow's* THE MOON (Abelard-Schuman, rev. ed., 1959, $2.75); without the gorgeous pictures of the Binder book, Gamow's longer, more conventional account of our satellite seems, in comparison, almost dull.

Sure to fascinate almost any adult or younger person is A GUIDE TO THE PLANETS, by Irish astronomer *Patrick Moore* (Norton, rev. ed. 1960, $6.50), a vividly-written account of the various planets, with intriguing comments on how they were discovered and studied. A little less technical than Whipple's elementary text "Earth. moon and planets," Moore's Guide has all the wonder and magic of some of the old time astronomy books, with their Doré engravings, that we pulled out of Grandfather's bookshelves; good pictures, many in color, and an appendix of suggested work for the amateur. Some of the same information is well presented, for ages 11 up, in *Otto Binder's* PLANETS (Golden Press, 1959, $.50), another beautifully illustrated primer in the "Golden library" series.

OUT OF THE SKY (Dover, 1959, $1.85), is a welcome cheap reprint of *H. H. Ninger's* semi-popular introduction to meteoritics, 1952, which will appeal to the scientist and serious layman interested in mineralogy or in the earth's origins; well illustrated; good bibliographies.

Every oil man will want THE AMERICAN PETROLEUM INDUSTRY: THE AGE OF ILLUMINATION, 1859-1899, by *Harold F. Williamson* and *A. R. Daum* (Northwestern U. Press, 1959, $7.50), the first volume in a projected two-volume definitive history of the business. All phases of the industry are examined: prospecting, production, transport, refining and marketing; illustrations are fine, and there is an extensive bibliography.

ROCK CHIPS

by SANDSTONE SAM

Minds are like parachutes: they only function when open.

courtesy RMAG Newsletter

• • •

From the literature—"from the east-northeast trend in the east (the structure) gains a north-south direction toward the west. This and the change in the regional strike from north-south in the northern part to southeast and east in the southern part leads to the assumption that this is the west-dipping end . . ."

• • •

From a 1954 guidebook of a state survey—"the Cannonball member correlates with itself wherever found."

• • •

Students report—"an example of folded mountains are the APPLICATION Mountains," and "the Henry Mountains of Utah are DOOM Mountains.

NO, THIS ISN'T OUR NEW OFFICE —IT'S JUST THAT THE TIDE WENT OUT"

by George Ludway

INTERNATIONAL SERIES OF MONOGRAPHS ON EARTH SCIENCES

General Editor: EARL INGERSON

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CUMULUS DYNAMICS

Edited by DR. CHARLES E. ANDERSON, Geophysics Research Directorate, Air Force Cambridge Research Center, Bedford, Mass., U.S.A.

Proceedings of the first Conference on Cumulus Convection held in May, 1959, under the auspices of the Geophysics Research Directorate. In preparation

DYNAMICS OF CLIMATE

Edited by RICHARD L. PFEFFER, Ph.D., Geophysics Research Directorate.

Proceedings of a conference on the application of numerical integration techniques to the problem of the general circulation sponsored jointly by the Institute for Advanced Study and the U.S. Air Force Geophysics Research Directorate. $6.50

GEOLOGY OF THE U.S.S.R.—A Short Outline

D. V. NALIVKIN, translated by S. I. TOMKEIEFF.

An outstanding Russian monograph of great topical interest. In preparation

GEOCHIMICA ET COSMOCHIMICA ACTA—Journal of the Geochemical Society

Executive Editors: C. W. CORRENS, Gottengen; E. INGERSON, Austin, Texas; L. R. WAGER, Oxford; assisted by Regional Editors and an International Editorial Advisory Board. (Monthly. Three volumes per annum) Subscriptions: Rate A. $20 per volume, Rate B. $21.50 per annum. Members of the Geochemical Society or non-members who occasionally publish in the Journal, $10 per annum.

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GEOLOGY USSR *(Continued from page 25)*

for Kola Peninsula and Karelia, V. I. Luchitzky for the Ukrainian shield, D. S. Korzhinsky for the Sub-Baikal region and the Aldan shield in Siberia. With the help of a large number of deep boreholes a palaeogeological map of the Pre-Cambrian floor of the Russian platform was produced and such a survey allowed N. S. Shatsky to establish a new Proterozoic system in the U.S.S.R.—the Rhiphaean system *(Proc. Geol. Soc. London,* 1953, no. 1501, p. cviii). The Rhiphaean system embraces arenaceous and argillaceous unmetamorphosed strata and forms the upper part of the Proterozoic succession as developed in the eastern part of the Russian platform and the Urals. The Rhiphaean system may be correlated with the Sinian system of China, and the Eocambrian or Sparagmitian groups of Norway, as well as with the numerous Proterozoic systems of India, Africa and America. Attempts at correlation of the deposits of this system by means of spores have been made but without, as yet, positive results.

Cambrian, Ordovician and Silurian. Deposits of the Cambrian system have been studied in many localities and great progress has been made in the establishment of a detailed stratigraphical scale of Cambrian deposits in the Siberian platform based on trilobites. This has involved the creation of two additional stages—Aldan stage and Lena stage. In the same way the Cambrian deposits of Kazakhstan have been classified on the basis of trilobites. Cambrian rocks have been found in the southern Urals and the Caucasus. Deep boreholes have revealed a widespread occurrence of the Lower Palaeozoic rocks in the Russian platform. It is only during the last few decades that Ordovician has acquired the status of a system in the U.S.S.R., for the deposits normally assigned to this system were called Lower Silurian. The deposits of the Ordovician and the Silurian systems, so well developed in the Baltic region, have been studied there in great detail. In Siberia and Kazakhstan these deposits were subdivided either on the basis of brachiopods and tabulate corals or on the basis of graptolites.

Devonian. For a number of years the deposits of this system were studied and revised by a team of geologists under the leadership of D. V. Nalivkin. This led to the creation of a new stratigraphical scheme for the Devonian as found on the Russian platform, and particularly to a complete revision of the demarcation between the Middle and the Upper Devonian. At the same time a completely new scheme of Devonian correlation in the Baltic lands, Timan, Urals and Central Russia was established. Marine Devonian deposits were found in the Caucasus and the Far East. A stratigraphical subdivision on the basis of spores was proposed. In certain localities petroleum was found in large quantities.

Carboniferous. Because of its important coal reserves and also of the newly discovered petroleum and gas, the deposits of this system have been intensively studied. A new detailed and elaborate stratigraphical scheme has been proposed. According to the scheme the Middle Carboniferous is subdivided into the Moscovian and the Bashkirian stages and the Upper Carboniferous into the Kasimovian and Gzhelian stages. Suggestions have also been made to suppress altogether the Namurian stage. Great progress has been made, especially with the help of micropalaeontology, in the study of the strata of the Kuznetzk and Tunguska coal basins in Siberia. Deep borings have revealed many new coalfields in the Ukraine, the northern Caucasus, Vorkuta and the northern Urals.

Permian. Great progress has been made in the study of this, specifically Russian, system. Detailed stratigraphical subdivision has been revised and a new, Sakmarian stage has been placed below the Artinskian stage. The boundary between the Permian and the Carboniferous has been reconsidered on the basis of the *Schwagerina* horizon. This means that a certain thickness of the Upper Carboniferous strata has been included in the Permian system. It was realized that in many geosynclinal regions the Permian transgression is of great importance. Discoveries of Permian deposits have been made in the Caucasus as well as in Pamir, Novaya Zemlya, Taimyr and other Siberian localities. The work of A. N. Krishtofovich on the Angara floral and climatic zonality is of exceptional value. It helped to classify the continental deposits of the Upper Palaeozoic age, which are so abundant in the U.S.S.R.

Trias. The deposits of this system were formerly known in only a few isolated localities of the U.S.S.R. At the present time many deposits of marine Trias have been discovered in the Crimea, Caucasus, Pamir and various Siberian localities. Continental Triassic deposits have been proved

to be widespread in the Russian and Siberian platforms. A detailed study has been made of the vast Triassic igneous province of Central Siberia, the province of the so-called "Siberian Traps."

Jurassic. Detailed studies of Jurassic deposits have been carried out in the Volga region, the Dnieper-Donetz depression, the Crimea and the Caucasus. Deep borings have revealed a widespread occurrence of Jurassic deposits in the West Siberian Lowlands and Turgai Strait. Palaeobotanical work has made possible a precise determination of the age of various facies of the Jurassic coal-bearing strata of Central Asia and Siberia.

Cretaceous. The most profitable studies of the Cretaceous deposits have been carried out in the Caucasus and Kopet-Dagh. These involved zoning and the study of various facies such as the flysch facies which were compared with those of the Carpathians and the Caucasus. Palaeobotanical research has helped in the stratigraphical subdivisions of the continental Cretaceous deposits of the Asiatic part of the U.S.S.R.

Tertiary. After much deliberation the majority of Soviet geologists have come to the conclusion that the most suitable division of the Tertiary for the U.S.S.R. is a two-fold division of Palaeogene and Neogene. Micropalaeontological research, so often carried out in petroliferous areas, was of great help in the subdivision and correlation of the Tertiary deposits. In the light of this new palaeontological data a critical revision of the well established West European stages of the Tertiary deposits has been made. Detailed work has been carried out on the deposits of the Neogene seas in the region of the present basins of the Black, Azov and Caspian Seas. This work has led to a detailed palaeogeographical analysis of the Crimean-Caucasian geological province. New work has been published on the Tertiary deposits of Sakhalin and Kamchatka, which are quite distinct from those of the southern part of European Russia and Transcaucasia.

Quaternary. Detailed stratigraphical schemes for the evolution of ancient seas and their correlation with the stages of glaciation have been proposed by a number of geologists. Palaeobotanical studies have established five floral assemblages, characterizing the continental Quaternary deposits. Various methods of correlation have been used—spore-pollen, carpological, diatomic and radio-carbon. The term

"Anthropogene," proposed to replace the term "Quaternary" by Pavlov, found favour with certain geologists but has not as yet replaced it. A vast accumulation of data by I. P. Gerasimov and K. K. Markov provided material for a large monograph on the glacial period and for a textbook of Quaternary geology. Quaternary chronological charts and maps have been published at various times.

Detailed studies in stratigraphy have led a number of geologists to be critical of correlation by means of leading fossils. A much wider approach is suggested, based on the entire assembly of fauna and flora at any given stage, as well as on the consideration of facies, physicochemical environment and the tectonic processes.

Publications on stratigraphy include many volumes of the "Stratigraphy of the U.S.S.R.," and the "Regional Stratigraphy of the U.S.S.R.," as well as numerous textbooks of stratigraphy, among which the best known are by A. A. Borisyak, A. N. Mazarovich and N. M. Strakhov.

Tectonics

Anyone reading the magnificent tectonic synthesis of the world as presented at the end of the last century by Edward Suess in his "Face of the Earth" could not fail to note the large amount of information about the tectonics of the Russian Empire provided and interpreted by A. P. Karpinsky and other Russian geologists. A. P. Karpinsky (1847-1936) was the great creative genius of the period. It was he who in Russia linked together into one whole sedimentation, stratigraphy, palaeogeography and tectonics. In this he was assisted by I. D. Chersky (1845-1892), V. A. Obruchev (1863-1956) and I. V. Mushketov (1850-1902). The work of Obruchev was continued well into the present century.

After the October Revolution the increased demand for accurate information regarding economic deposits led to an intensification of geological surveying including the method of deep boring. This provided very rich material for the science of tectonics. It was also discovered that the investigation of the so-called tectonic form of strata, or metamorphic, or igneous complexes is incomplete if unaccompanied by a study of regional sedimentation and regional facies, lithogenesis, magmato-genesis and denudation. This discovery suggested a new approach to tectonics as a whole, as well as to its nomenclature and interpretation.

Only a few significant advances in the study of tectonics in the U.S.S.R. can be mentioned here. Thus in 1931 the famous Russian tectonist M. M. Tetyaev emphasized, what he has called "the principle of unity in the development of the earth's crust," that is, that sedimentation and tectonics form two contrasted phases of the same process. In his "Principles of Tectonics" published in 1934 Tetyaev emphasized the "undulatory" vertical movement in the earth's crust, which may in certain cases be transformed into tangential movements. Contemporaneously, in their historical study of the development of geosynclines, a number of Russian geologists began to apply an historico-geological analysis involving a careful record of facies and of the thicknesses of sediments, particularly in their historical study of the development of geosynclines. In this new light, Central Kazakhstan was studied by N. S. Shatsky, the Caucasus by V. V. Belousov, and Central Asia by V. I. Popov.

At a later date D. A. Arkhangelsky, in his book "The Geological Structure and the Geological History of the U.S.S.R.," published in 1948, summed up all the newly promulgated theories on the historical development of geosynclines. At the same time the tectonics of platforms was being developed by A. P. Pavlov and N. S. Shatsky, the authors distinguishing a large number of new structural features, such as foundation and cover, syneclises (downwarps) and anticlises (upwarps), swells and foreland depressions. During this period two principal interpretations of observed tectonic features on a large scale emerged. One theory, defended by Shatsky, is that in the course of an extensive tectonic development, there is a general inversion of tectonic forms, the simplest case being the transformation of a geosyncline into a geanticline. The other theory, favoured by Tetyaev and Belousov, is the theory of inheritance of tectonic forms, as when the leading tectonic lines of one orogenic epoch follow in the main the tectonic lines of the previous orogenic epoch. Both sides, however, were very critical of the doctrine of sharp and isolated phases of orogenesis, which they called catastrophism, and on the whole were inclined to support the idea of continuous orogenic movements, only varying in their intensity. The tectonists of the new school were also very critical of the theory of large nappes as applied to the interpretation of certain Alpine mountain chains like the Carpathians.

Other subjects widely discussed in the U.S.S.R. are the concept of "deep fractures" advanced by A. P. Peive, and the concept of "neotectonics" or the folded and faulted structures among the Quaternary deposits as put forward by V. A. Obruchev. Of great interest and value is historical tectonic analysis, based on statistical estimation of the volumes and composition of the stratified deposits during a given period or era. This work was successfully carried out by A. B. Ronov and led to the preparation of "palaeogeological" maps as well as "tectonic" maps of a revised type. The first tectonic map of this type, embracing the whole of the U.S.S.R., was published on the scale of 1:4,000,000 in 1952. The second tectonic map of the U.S.S.R. on the scale of 1:5,000,000 was published in nine sheets in 1957. It was accompanied by an explanatory memoir of 78 pages written by N. S. Shatsky and A. A. Bogdanov (*Proc. Geol. Soc. London,* 1958, No. 1557, p. 29). This map in some ways is unique in its method of presentation and its colour schemes. It is coloured according to the orogenic ages of the formations. Tints and shadings indicate various folding phases, relation of cover to foundation, and also various structural types. From this map emerges the general structural pattern of the U.S.S.R., made of two main platforms, the Russian and the Siberian, bounded by the Caledonide-Hercynide folded belts, margined by the Mesozoids on the east and by the Alpinides in the south and in the Far East along the Pacific Ocean coast. The term "Baikalian folding" is a new term proposed by Shatsky for the late Proterozoic orogenic epoch coeval with the Rhiphaean period which is more or less equivalent to the British Charnian. The map and the memoir together provide a large amount of information regarding the tectonic structure of the U.S.S.R.

Soviet geologists are continually debating major and minor tectonic problems, bringing forward new points of view and new facts. Among the major problems is that of the difference between the continental or rigid parts of the Earth's crust and the marginal oceanic, or geosynclinal and mobile parts. It is argued by some that geosynclines may involve in themselves rigid tectonic elements, while rigid platforms may be subject to deformation; that folding may be due not only to lateral pressure but to

a number of other factors; that deep-seated folds and deep-seated fractures may exercise a profound influence on surface tectonic features. Finally they ask what is the source of the energy which produces all the tectonic movements in the earth's crust?

Geomorphology

Closely connected with tectonics is the science of geomorphology, the principal aim of which is the study of the contemporary relief of the earth. Especially close to geomorphology is "neotectonics." Already in the 18th century Russian scientists were interested in the changing levels of the Baltic Sea. During the 19th century geomorphology, as a part of physical geography, developed to include mountain forms, river systems, glacial features and sea levels. Still greater progress in the science of geomorphology has been achieved since the Revolution. The main advances are discussed in a book by K. K. Markov "Fundamental Problems of Geomorphology" published in 1948. In this book the author introduces a new concept which he calls "geomorphological levels," which provide a characteristic criterion for each stage in the evolution of the earth's surface. The book also has a review of all the recent research on the seas, sea shores, rivers, lakes and marshes, mountains, steppes and deserts, ravine development, karst landscape and loess. A new development of a science, called by A. V. Kabakov "dynamic palaeography," aims not only at the restoration of the margins of the ancient seas and oceans, but also at the description of the former physico-geographical and climatic conditions. This aspect of geomorphology is presented in "Palaeogeography" by K. K. Markov, published in 1951, while the whole subject of geomorphology is outlined in the "Principles of geomorphology" by Y. S. Edelstein, published in 1938.

Geophysics

The headquarters of the study of geodesy, which was so well developed in pre-revolutionary Russia, is at present in the "Central Institute of Geodesy, Aerophotography and Cartography." A new triangulation network over the territory of the U.S.S.R. has been laid down and new methods of survey, for example geodesic gravimetry and aerosurveying, have been developed. Geophysics is studied in various institutions and colleges, especially in the Institute of Applied Geophysics, the Institute of the Physics of

the Atmosphere, the Institute of the Physics of the Earth and in the Geophysical Institute. Seismology, a traditional Russian science, as demanded by its numerous earthquake regions, has been tremendously widened in scope and a number of new seismological stations have been established. Seismic survey has also been developed, and considerable progress made in gravimetry, magnetometry and electrometry. The physical features of lakes, seas and oceans have been continuously observed. The physics of the atmosphere has been investigated by a number of new methods, especially through the use of rockets, strato-balloons, spectroscopy, radioprobes and other modern techniques. The thermal regime of the earth has been studied by E. A. Lubimov and geoelasticity by M. S. Molodensky. A. N. Khramov has summarized the methods and results achieved by a large number of workers on the age of the earth and palaeomagnetism in his book (published in 1958) "Palaeomagnetic correlation of sedimentary formations." This book is in two parts, the first containing the summary just mentioned and a bibliography, the second containing a detailed account of the palaeomagnetic work carried out on a sedimentary formation of Jurassic to Tertiary age in the Cheleken Peninsula in the Western Turkmenistan.

(To be concluded in GEOTIMES, *September 1960 issue)*

AGI Education Conference

The broad range of AGI activities in education were the subject of review at a one-day conference on Education in the GeoSciences held in Washington on May 18. Representatives from industry, government agencies, private foundations and several AGI Member Societies invited to the conference heard representatives of various AGI educational efforts discuss programs in youth education, adult education and the training of career scientists.

President Raymond C. Moore welcomed the group on behalf of AGI. Dr. Chalmer J. Roy presided over the meeting and discussions of various AGI educational programs were led by Robert L. Heller, Chalmer L. Cooper, Hall M. Taylor and Robert C. Stephenson.

Future conferences in education are planned to deal more specifically with topics of limited dimensions.

ENERGY 2059 *(Continued from page 21)*

main more or less constant over the next hundred years at around the present rate of use.

Nuclear, Solar, Geothermal, Tidal and Other Inorganic Energy Sources

Potential supplies of inorganic sources of energy are practically unlimited. It will be noted on Figures 1, 2 and 3 that energy from inorganic sources will be relatively little employed for the next 30 or 40 years, just as in the case of oil from shales and from coal, and to some degree also from tar sands. Only after 50 years or more will their use begin to assume proportions comparable to that of natural petroleum. The rapid growth of energy demand, however, will need to be met over the final half of the next hundred years predominantly by coal-derived energy and by energy from nuclear, celestial and other inorganic sources. The need to depend on these sources will probably be less urgent in Canada than in the United States or in the world as a whole.

Among the principal deterrents to the rapid growth in the use of nuclear energy, in addition to the hazards involved, are the capital costs. These are some two or three times those for the conventional use of coal or petroleum, hence, for some time, nuclear energy will be used mainly for special situations on land and sea, uses that do not bulk large in the total energy demand picture. Development of atomic energy in connection with chemical or other types of production processes will permit a division of capital operating costs, which will no doubt help to bring about a more favorable economics. This characteristic of atomic energy use seems to be one of its auspicious aspects. A possible use of atomic energy that is contemplated and will be tried is in the recovery of other sources of energy, such as the fossil fuels, by the production of underground heat, by means of explosions or by introduction of atomic wastes into the subsurface formations.

Another inorganic source of energy that has definite possibilities is geothermal. Its utilization may involve the direct use of the internal heat of the earth. This source of energy is actually being used in a few places today, such as in Italy and in Iceland, where high temperatures exist close to the surface of the earth and where there is subsurface water permeability. Other methods of utilizing the

Table 2 WORLD
CRUDE OIL AND LIQUID PETROLEUM GAS
(AS OF JANUARY 1,1960 — IN BILLIONS OF BARRELS)

COUNTRY OR AREA	CUMULATIVE PRODUCTION	PROVED RESERVES	CUMULATIVE DISCOVERIES	ULTIMATE RESOURCES
UNITED STATES	66.60	36.00	102.60	270.0
CANADA	1.30	4.00	5.31	85.0
BALANCE N. AMERICA	3.30	2.50	5.80	25.0
TOTAL N. AMERICA	71.21	42.50	113.71	380.0
SOUTH AMERICA	15.91	22.00	37.91	196.0
TOTAL W. HEMISPHERE	87.12	64.50	151.62	576.0
EUROPE	0.79	1.50	2.29	19.0
AFRICA	0.04	10.00	10.04	100.0
MIDDLE EAST	14.63	220.00	234.63	780.0
FAR EAST	3.49	11.50	14.99	85.0
TOTAL E. HEMISPHERE	18.95	243.00	261.95	984.0
TOTAL FREE WORLD	106.07	307.50	413.57	1560.0
IRON CURTAIN	13.89	30.25	44.14	440.0
TOTAL WORLD	119.96	337.75	457.71	2000.0

large geothermal sources of energy will no doubt be developed. Also, temperature differences within the earth could be created artificially by atomic explosions. Utilization of the vast amount of energy that is represented by the tides is also a possibility within the next 100 years.

Many thousand times more energy comes to the earth's surface from the sun than the total of all energy used by man. Scarcely any of this is used because man has not yet developed the means to avail himself of it. If the billions spent on nuclear research had been spent instead on solar energy, and with the same degree of urgency, we would probably be using solar energy today. A number of schemes for the utilization of solar energy have been investigated or considered. These include—in addition to the more obvious physical devices—the conversion of sunlight to electrical energy by various

1958 ENERGY PRODUCTION AND CONSUMPTION

Table 3 (IN TERMS OF BILLIONS OF BARRELS OF OIL)

	CANADA		U.S.A.		WORLD	
OIL PRODUCTION	0.17	0.2	2.4	4.5	6.6	9.1
GAS PRODUCTION	0.03		2.1		2.5	
COAL PRODUCTION		0.11		4.0		20.5
WOOD, FARM WASTES, AND WATER POWER		0.09		0.5		5.0
TOTAL PRODUCED ENERGY		0.4		9.0		34.6
OIL IMPORTS	0.10	0.11		0.9		
GAS IMPORTS	0.01					
COAL IMPORTS		0.09				
TOTAL IMPORTED ENERGY		0.2		0.9		
TOTAL CONSUMED ENERGY		0.6		9.9		34.6

means, including those of photochemical reactions, and controlled nonbiological photosynthesis. It is the latter which now appears to have the greatest promise when the means to arrive at the basic reactions are discovered. Conversion of solar to electrical energy on a broad commercial scale will no doubt one day be solved. Man will not have to depend only on the energy arriving at the earth's surface from

CANADA

SCHEDULE OF ESTIMATED ENERGY USE BY SOURCE CATEGORIES
FOR EACH 20 YEAR PERIOD 1960 TO 2059
(IN TERMS OF BILLIONS OF BARRELS OF OIL)

Table 4

	OIL AND GAS			COAL CONVERSION TO		WOOD, FARM WASTES AND WATER POWER	NUCLEAR, SOLAR GEOTHERMAL ETC. ENERGY	TOTALS
	DOMESTIC	IMPORTS	SHALE OIL	PETROLEUM	OTHER FORMS OF ENERGY			
POTENTIAL SUPPLIES	515		500	4200		13.5	∞	
20-YEAR PERIOD								
1960-1979	11	3	NONE	NONE	4	2	MINOR	20
1980-1999	30	5	MINOR	NONE	8	2.5	0.5	46
2000-2019	65	6	2	MINOR	12	3	10	98
2020-2039	100	8	12	9	30	3	48	210
2040-2059	95	8	35	30	100	3	173	444
TOTAL USED 1960-2059	301	30	49	39	154	13.5	231.5	818
REMAINING SUPPLIES	214		451	4007			∞	

UNITED STATES

SCHEDULE OF ESTIMATED ENERGY USE BY SOURCE CATEGORIES
FOR EACH 20 YEAR PERIOD 1960 TO 2059
(IN TERMS OF BILLIONS OF BARRELS OF OIL)

Table 5

	OIL AND GAS			COAL CONVERSION TO		WOOD, FARM WASTES AND WATER POWER	NUCLEAR, SOLAR GEOTHERMAL ETC. ENERGY	TOTALS
	DOMESTIC	U.S. IMPORTS	SHALE OIL	PETROLEUM	OTHER FORMS OF ENERGY			
POTENTIAL SUPPLIES	570		2000	14,000		50	∞	
20-YEAR PERIOD								
1960-1979	120	50	MINOR	MINOR	100	10	MINOR	280
1980-1999	140	240	20	20	130	10	20	580
2000-2019	120	240	80	200	350	10	200	1200
2020-2039	70	180	200	500	820	10	700	2480
2040-2059	40	100	300	900	1690	10	2040	5080
TOTAL USED 1960-2059	490	810	600	1620	3090	50	2960	9620
REMAINING SUPPLIES	80		1400	9,290			∞	

WORLD

SCHEDULE OF ESTIMATED ENERGY USE BY SOURCE CATEGORIES
FOR EACH 20 YEAR PERIOD 1960 TO 2059
(IN TERMS OF BILLIONS OF BARRELS OF OIL)

Table 6

	OIL AND GAS			COAL CONVERSION TO		WOOD, FARM WASTES AND WATER POWER	NUCLEAR, SOLAR GEOTHERMAL ETC. ENERGY	TOTALS
	DOMESTIC	U.S. IMPORTS	SHALE OIL	PETROLEUM	OTHER FORMS OF ENERGY			
POTENTIAL SUPPLIES	5,500		12,000	56,000		500	∞	
20-YEAR PERIOD								
1960-1979	300	50	MINOR	MINOR	510	100	MINOR	960
1980-1999	1,050	240	40	40	860	100	40	2,370
2000-2019	1,000	240	400	400	2,300	100	760	5,200
2020-2039	900	180	1,200	1,000	5,000	100	3,120	11,500
2040-2059	600	100	2,000	1,800	10,000	100	9,400	24,000
TOTAL USED 1960-2059	3,850	810	3,640	3,240	18,670	500	13,320	44,030
REMAINING SUPPLIES	840		8,360	34,090			∞	

the sun; he will eventually find a way of transferring it to the earth from outer space.

Potential Supply and Demand

Figures 1, 2 and 3 are based on Tables 3, 4, 5 and 6. All figures in the tables are in terms of billions of barrels of oil. Table 3 gives the recent annual production and consumption of the presently used sources of energy. Total energy use in 1958 was equivalent to 600 million barrels of oil in Canada, 9.9 billion in the United States and 34.6 billions for the world as a whole. The sources of this energy supply are shown in the table.

The schedule of total energy use for each 20 years by source categories is shown in Tables 4, 5 and 6 for Canada, the United States and the world respectively. Present total supplies of oil and gas include both primarily and secondarily recovered oil and associated petroleum gas liquids, as well as petroleum gas, and tar sand oil. In other words, they include all of the natural, saturated hydrocarbons. Thus, they do not include the oil we could get from oil shales, coal etc. On the basis of these figures, a little less than 60% of present Canadian potential natural petroleum supplies, as compared to 88% of those for the United States and 85% of those for the world, will have been consumed in the next 100 years.

It has no doubt been observed that column 2 on the three tables is for oil imports. On Tables 5 and 6 the figures are for imports into the United States. These today run about 12 to 14 percent of world production. This percentage was gradually increased to a maximum average of about 19% of world production for the years 2000-2019, and then gradually decreased to an average of about 14% over the 2040-2059 period.

For Canada, oil imports will not be an important part of the picture. However, on account of the logistics involved and the cost differential as between operations in some of the Canadian basins and certain foreign sources of large supply, some importation of oil into Canada will probably long continue to be economically sound. This differential would appear to exist particularly with respect to Arctic oil, and possibly even to much of the tar sand oil. It is largely for this reason that the forecast does not show a larger proportion of projected energy needs supplied by petroleum in the final half of the century, even though the potential supplies are shown to exist. Incidentally, in another fifty years it is likely that the cost differential that now exists between hydrocarbon fuels and coal and shale oil and some of the inorganic energy sources may be considerably changed.

Of shale oil only about 10% of Canada's existing potential supplies will have been used. In both the U. S. and the world it figures at about 30%. Of present potential coal supplies, only about 5% of Canada's indicated present potential supplies will have been called on, as compared to about 33% for both the U. S. and the world. As for wood, farm wastes and water power, which may be assumed

to be in large part renewable, only that estimated to be used during the century is shown. As previously stated, it is assumed that their total use will continue rather constant during the next century, as in that just completed.

Potential supplies of nuclear, solar, geothermal and other inorganic sources of energy are shown as infinite, and they will remain so at the end of the century. In fact, it may confidently be expected that by the year 2059, atom energy sources and methods of tapping and using them that are undreamed of today will have come into use.

The amount of inorganic energy, as well as that from coal and shale oil, will vary with (1) the total energy demand, and (2) the relative economics and convenience of their use. The precentage use of energy from inorganic sources will increase but little over the world until later in the 20th century, when it will begin to grow rapidly. Here, in some one or more of the forms of inorganic energy, lies the greatest challenge to the use of coal, and possibly petroleum. Any serious challenge is, however, many years off. The fossil fuels will by then have established themselves in supplying so many necessities of man, for which only they are adaptable, that the advent of other energy will be more of a benefit than otherwise.

It may now be of interest to see the same data in a little different form in Tables 7, 8 and 9. Here the data are shown, not in terms of billions of barrels of oil but by the percentage of total demand that it is estimated to be supplied from each source category in successive 20-year periods. The picture is the same as that in Tables 4, 5 and 6, except that it is in percent of total rather than in billions of barrels of oil. It should be kept in mind, however, that a percentage decrease in use from any one source does not necessarily indicate a volume decrease.

Many Possible Modifying Factors

No apology is made for any of the estimates of the various supplies basic to these forecasts. On the basis of the assumptions set forth at the outset, these are considered to be realistic. Anyone is at liberty to disagree both with the estimates and with the manner in which their use is distributed over the 100 years. What will actually occur will depend on scientific and technological developments and break-throughs which may greatly facilitate the use of certain of the great sources of energy in ways and to extents that are not now easily predictable. The tables and graphs provide a frame of reference within which one may juggle the components in ways to suit his beliefs or his fancy.

With regard to ultimate petroleum resources, it is felt that the burden of proof would rest heavily on anyone who would like to picture these in a quite different order of magnitude. When one considers the total energy demand that the people of the world can reasonably look forward to during the period under consideration, any change in the petroleum supply picture would have to be one of unlikely great magnitude to change materially the ratio of petroleum energy supply to total energy demand from that set forth.

CANADA

SCHEDULE OF ESTIMATED ENERGY USE BY SOURCE CATEGORIES
FOR EACH 20 YEAR PERIOD, 1960 TO 2059
(IN TERMS OF PERCENTAGE OF TOTAL ENERGY)

Table 7

20-YEAR PERIOD	OIL AND GAS DOMESTIC	OIL AND GAS U.S. IMPORTS	SHALE OIL	COAL CONVERSION TO PETROLEUM	COAL CONVERSION TO OTHER FORMS OF ENERGY	WOOD, FARM WASTES, AND WATER POWER	NUCLEAR, SOLAR, GEOTHERMAL, ETC. ENERGY	TOTALS
1960-1979	55.0%	15.0%	—	—	20.0%	10.0%	MINOR	100.0%
1980-1999	65.2	10.9	MINOR	—	17.4	5.4	1.1%	100.0
2000-2019	66.3	6.1	2.1%	MINOR	12.2	3.1	10.2	100.0
2020-2039	47.6	3.8	5.7	4.3%	14.3	1.4	22.9	100.0
2040-2059	21.4	1.8	7.9	6.8	22.5	0.7	38.9	100.0
OF TOTAL	36.7	37	6.0	4.8	18.8	1.7	28.3	100.0

UNITED STATES

SCHEDULE OF ESTIMATED ENERGY USE BY SOURCE CATEGORIES
FOR EACH 20 YEAR PERIOD, 1960 TO 2059
(IN TERMS OF PERCENTAGE OF TOTAL ENERGY)

Table 8

20-YEAR PERIOD	OIL AND GAS DOMESTIC	OIL AND GAS U.S. IMPORTS	SHALE OIL	COAL CONVERSION TO PETROLEUM	COAL CONVERSION TO OTHER FORMS OF ENERGY	WOOD, FARM WASTES, AND WATER POWER	NUCLEAR, SOLAR, GEOTHERMAL, ETC. ENERGY	TOTALS
1960-1979	42.9%	17.9%	MINOR	MINOR	35.7%	3.5%	MINOR	100.0%
1980-1999	23.7	40.7	3.4%	3.4%	23.7	1.7	3.4%	100.0
2000-2019	10.0	20.0	6.7	16.7	29.2	0.8	16.6	100.0
2020-2039	2.8	7.3	8.0	20.2	33.1	0.4	28.2	100.0
2040-2059	0.8	2.0	5.9	17.7	33.3	0.2	40.0	100.0
% OF TOTAL	5.1	8.4	6.2	16.8	32.1	0.5	30.8	100.0

WORLD

SCHEDULE OF ESTIMATED ENERGY USE BY SOURCE CATEGORIES
FOR EACH 20 YEAR PERIOD, 1960 TO 2059
(IN TERMS OF PERCENTAGE OF TOTAL ENERGY)

Table 9

20-YEAR PERIOD	OIL AND GAS DOMESTIC	OIL AND GAS U.S. IMPORTS	SHALE OIL	COAL CONVERSION TO PETROLEUM	COAL CONVERSION TO OTHER FORMS OF ENERGY	WOOD, FARM WASTES, AND WATER POWER	NUCLEAR, SOLAR, GEOTHERMAL, ETC. ENERGY	TOTALS
1960-1979	31.3%	5.2%	MINOR	MINOR	53.1%	10.4%	MINOR	100.0%
1980-1999	44.3	10.1	1.7%	1.7%	36.3	4.2	1.7%	100.0
2000-2019	19.3	4.6	7.7	7.7	44.2	1.9	14.6	100.0
2020-2039	7.8	1.6	10.4	8.7	43.5	0.9	27.1	100.0
2040-2059	2.5	0.4	8.3	7.5	41.7	0.4	39.2	100.0
% OF TOTAL	8.7	1.8	8.3	7.4	42.4	1.1	30.3	100.0

Cost Factors

The factor which, more than any other, could change the rate of increase in the use of energy from that which has been assumed in constructing the accompanying tables and graphs is man's ability to make energy abundantly available in convenient form for its many uses at generally acceptable prices. Much depends, in other words, on the extent to which man can afford to be wasteful. On the one hand, it is conceivable that energy may be made so abundantly and cheaply available as to call forth a much more rapid acceleration of use than herein envisioned. On the other hand, a lesser rate of availability of energy, and attendant increased costs, will be accompanied by a decrease in gross energy use. This decrease will be offset in some degree by an increase in efficiency of use. In this latter respect, there is much room for developments in nearly every aspect of our life and habits.

Petroleum Will Become a Chemical Industry

Eventually, the petroleum industry will become in large degree a chemical industry. It will predominate in the new era of petrochemicals. It will contribute to and participate predominantly in the development of plastics and fibers, construction materials and materials used in agriculture. In fact, the oil industry will provide the raw materials and fashion the building blocks for hundreds of products useful to man.

Petroleum will also participate in a major way, so we are told, in the great future for nuclear energy, particularly in space travel, astronautic as well as aeronautic. It will do this because the elements that make up petroleum are essential raw materials for use in combination with rocket propellants for their most efficient operation. The same applies, of course, to missiles.

So uniquely favorable is petroleum as a source of energy that it will undoubtedly be long preferred among fuels. So uniquely attractive is the composition and chemistry of petroleum, and the flexibility of its chemistry, that when natural supplies tend toward exhaustion, it may not be surprising if man finds a way to synthesize hydrocarbons and fashion them to his needs.

Petroleum Producing Industry Problems

Although there is a great future for secondary recovery, in the newer fields much more of the oil will probably be recovered by means of improved primary production techniques. There will be break-throughs in the techniques of drilling and in reducing casing costs. As these well costs today account for nearly half of the expenses of the producing industry, anything that can reduce them is very important. For one thing, it will add to reserves, which is the amount of oil that can be produced economically. While there will be important reserves found by drilling deeper in many places, there are sound geological reasons why the total amount of oil to be so added will not be as great as is commonly assumed.

There will be great improvements in the economics of offshore operations through improved techniques. In some areas at present, such as off the Gulf Coast, the large sums spent are considered by some operators today to be scarcely justified. The continental shelf areas of the world are not to be lightly disregarded however. The total of all shelf areas of the world represents an area close to 10 million square miles. Of this, the total of all shelf areas in which the prospects range from slight to excellent, or on a par with those of land basins, is about three million square miles. This is a total combined oil prospective basin area equal to the entire area of the 48 states of the United States.

One of the most difficult problems for management will be to find the cash requirements. Industry will, more and more, have to contend with competition for the earned dollar. In this respect the problems of the present are modest indeed. Availability of capital will depend, as now, on a satisfactory return on investment. Emphatically, the need for the depletion allowance will grow. To its credit, it should be recorded that no industry, past or present, has had a better record in holding down costs to the public than the oil industry.

More Research Needed

The petroleum industry will need to accelerate its research to keep abreast not only with intra- but with inter-industry competition. In few industries are the rewards to be anticipated from research as great as in that of petroleum. More attention needs to be given to basic research, either by the oil industry

itself, or by subsidies at research institutions, universities, etc. It is well to remember that all of our wealth, all that man possesses in the world today, has resulted from some basic discovery in the past. There also needs to be a more realistic attitude toward those in research to get the most for the research dollar.

Man stands today in the world of science not far from where Adam stood at the dawn of creation. A whole new world lies before him, a world infinitely vaster than anything ever before contemplated. Each successive generation will see more advance than the two preceding. Let us not set a limit on the future because of what we have known in the past. The only reason that we have to worry about the future is to do something constructive about it; then we will find our frontiers becoming ever vaster. Man's greatest resource is his mind and his capacity for research. The mere existence of things does not insure their development and utilization. What we see as resources were not such to our ancestors, and the same will be true with respect to us. For anything to become a resource, man has to attain a culture to utilize it. As long as man's culture, his capacity for basic research, has healthy growth, his resources are bound to grow.

And so we may close as we began. Man will continue to spend billions on fathoming the secrets of nature and in building machines to utilize the forces. Unless he spends much more effort than he does today in fathoming himself, on learning the secrets and potentialities of the human being, there is more than an even chance that a wrathful Providence, in resentment at man's misuse of his bounty, will once again decide to let him live out the next 2000 years in the misery and the mess he has created.

STENSEN *(Continued from page 17)*

When Stensen returned to Copenhagen in 1672-74 he was still interested in geological problems. In his letters to friends in Italy, for instance, he mentions amber from excavations for the new fortifications of Copenhagen. He saw pieces of amber containing insects and also a big specimen contains *"a drop of movable air in a liquid, just as may be found in rock-crystals." "From this discovery one may draw various conclusions,"* says Nicolaus Steno, *"including the possibility that all the ground on which Copenhagen is built consists of marine deposits."* In the MINERALOGICAL MUSEUM (13) of Copenhagen some specimens from the same probable geological horizons are still preserved.

Figure 14. Ole Borch, 1626-1690, humanist, botanist, chemist was a life-long friend of Stensen. In his Prodromus, Stensen made mention of Borch's chemical laboratory. Print from 1754 of an original painting which is now lost.

Of Stensen's last visit to Copenhagen in 1685, nothing is left worth mentioning. He came as a Catholic Bishop and despite the fact that he had asked for and received the permission to return, his visit had to be as silent as possible. He administered the sacrament of Confirmation to some Catholics in one of the Catholic Ambassador's chapels in OESTERGADE (14). There is no building to which this action might be traced, yet there exist in Copenhagen two pictures which might

Figure 15. Domus Anatomica (Anatomical House) north of Our Lady's Church, adapted in 1644 at the initiative of Simon Pauli. Print from Thomas Bartholin, "Domus Anatomica . . . descripta 1662."

remind one of Stensen's last visits. In the Museum of the MEDICIN-HISTORICK SELSKAB (15) in Bredgade you may see a portrait found some years ago. Its origin is not known, yet there can be no doubt that it represents Niels Stensen probably as Royal Anatomist. The second portrait is to be found in the ANOTOMICAL INSTITUTE (16) of Copenhagen in the new campus of the university in the northern part of the city. It shows Stensen the bishop as painted by Chr. August Lorentzen.

Two royal palaces are also worthy of mention for their connection with the era of Stensen. One is ROSENBORG SLOT (18) (The Castle of Roses) built by Christian IV and surrounded by beautiful gardens. The castle today is a national museum which may well have among its collections products of goldsmith Sten Pedersen. The other is AMALIENBORG (19), the present residence of the royal family. It derives its name from Queen Sophie Amalie, the wife of Frederick III (1648-1670) and the mother of Christian V (1670-1695), who were the reigning kings of Denmark during Stensen's lifetime. It was at the request of Sophie Amalie's brother, Johann Friedrich, the Duke of Hanover, that Innocent XI appointed Stensen a bishop in 1677.

Stensen's remains were transferred in 1953 from the Crypt of S. Lorenzo in Florence to the Sarcophagus donated by the Italian government. At this time the author, Fr. Scherz, brought some bones enclosed in a shrine back to Denmark in

order to give them a place in a new Our Lady's School planned in a Copenhagen suburb.

Bibliography

Works by Stensen

Nicolai Stenonis (1667) *Elementorum Myologiae Specimen, sev Musculi descriptio Geometrica Cui Accedunt Canis Carchariae Dissectum Caput et Dissectus Piscis ex Canum Genere.* Florence.

Nicolai Stenonis (1669) *De Solido intra Solidum Naturaliter Contento dissertationis prodromus.* Florence. (First translated into English by "H.O." (Henry Oldenberg?) as *The Prodromus to a dissertation Concerning Solids Naturally Contained within Solids,* London, 1671. A later translation by J. Garret Winter, with a foreword by W. H. Hobbs, was published in New York in 1916).

Works about Stensen

A. Garboe (1954) *Nicolaus Steno (Niels Stensen) and Erasmus Bartholinus: Two 17th Century Danish Scientists and the Foundation of exact Geology and Crystallography.* Copenhagen.

A. Garboe (1959) *The Earliest Geological Treatise (1667) by N. Steno.* London.

Edv. Gotfredsen (1950) (Edited by) *A Dissertation on the Anatomy of the Brain by Nicolaus Steno.* Copenhagen.

Edv. Gotfredsen (1951) (Edited by) *Anatomical Observations of the Glands of the Eye and their new Vessels thereby revealing the true Sources of Tears by Nicolaus Steno.* Copenhagen.

Knud Larsen and Gustav Scherz (1941-47) *Nicolai Stenonis Opera theologica I-II.* Hafniae. (with German introduction and commentary).

Vilhelm Maar (1910) *Nicolai Stenonis Opera philosophica I-II. Copenhagen* (with English introduction and commentary).

Gustav Scherz (1952) *Nicolai Stenonis Epistolae et epistolae ad eum datae, I-II.* Hafniae, (with German introduction and commentary).

MIT RECEIVES SCHOLARSHIP GIFT

A gift of more than 1.25 million dollars was recently given by Mr. and Mrs. Eugene McDermott of Dallas, Texas to the Massachusetts Institute of Technology for scholarships to be awarded to students from Texas and other Southwestern states, with preference to those studying in the earth sciences. The establishment of the Eugene and Margaret McDermott scholarships resulted from a gift of 6,000 shares of stock in Texas Instruments Incorporated. Mr. McDermott is Chairman of the Executive Committee of Texas Instruments.

In 1959, another Texas Instruments executive, Cecil H. Green, and his wife gave M.I.T. a block of Texas Instruments stock then valued at $2.5 million to provide for an Earth Sciences Building (GeoTimes, May-June, 1959).

Approximately 24 McDermott Scholarships will be awarded in 1960-61, and the stipends will range from $200 for students with high qualifications but no financial need to $2,500 for those with limited means.

MINERAL EQUILIBRIA AT LOW TEMPERATURE AND PRESSURE, *by Robert M. Garrels, 254 pp., 1960, Harper and Brothers 49 E. 33rd St., New York 16, N. Y. $6.00.*

A compendium of low temperature aqueous chemistry data serves as a much-needed reference book for the geologist seeking to better understand the growing literature in geochemistry.

HISTORICAL GEOLOGY, *2nd Edition, by C. O. Dunbar, 500 pp., 1960, John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N. Y. $7.95.*

A revised edition of the widely used elementary historical geology text.

STRUCTURAL BEHAVIOR OF IGNEOUS ROCKS, *by Robert Balk, 177 pp., 1937, reprinted 1959, Memoirs Geol. Soc. of America, 419 West 117th St., New York, N. Y. $4.00.*

GEOLOGIC NAMES OF NORTH AMERICA INTRODUCED IN 1936-1955, *by D. Wilson, W. H. Sando, and R. W. Kopf. U. S. Geological Survey, Bull. 1056-A, 405 pp., 1956, U. S. Gov't Printing Office, $1.00.*

INDEX TO THE GEOLOGIC NAMES OF NORTH AMERICA, *by D. Wilson, G. C. Keroher and B. E. Hansen, U. S. Geological Survey, Bull. 1056-B, 622 pp., 1959, U. S. Gov't Printing Office, $0.60.*

BIBLIOGRAPHY OF U. S. GEOLOGICAL SURVEY REPORTS ON URANIUM AND THORIUM 1942 THROUGH MAY 1958, *by P. E. Soister and D. R. Conklin, U. S. Geological Survey, Bull. 1107-A, 167 pp., 1959, U. S. Gov't Printing Office, Washington, D. C., $0.50.*

HISTORY OF HUMBLE OIL AND REFINING CO., *by H. M. Larson and K. W. Porter, 769 pp., 1959, Harper and Bros., 49 E. 33rd St., New York, N. Y., $7.50.*

The documentary account of the growth and development of Humble pays significant tribute to the geologic corps which have exercised profound influence in the history of the company. Prepared under the auspices of the Business History Foundation, Inc.

STRATIGRAPHIC PRINCIPLES AND PRACTICES *by J. Marvin Weller, 725 pp., 1960, Harper and Bros., 49 E. 33rd St., New York 16, N. Y., $10.00.*

BOOKS *(Continued)*

This book presents a new well-rounded treatment of stratigraphy and the inter-related aspects of paleontology, sedimentology, and tectonics. The book, as its title indicates, concerns itself with principles rather than descriptive stratigraphy. This book stands out as an important addition to any geologist's reference shelf since stratigraphy is the keystone to geologic understanding.

THE GEOLOGICAL EVOLUTION OF NORTH AMERICA, *by T. H. Clark and C. W. Stearn, 434 pp., 1960, Ronald Press Co., 15 E. 26th St., New York 10, N. Y., $7.50.*

Intended for beginning courses in historical geology, this book is organized primarily on a regional basis with the objective of presenting the subject with greater continuity than is possible in the usual geologic period-by-period approach.

SCIENTIFIC MANPOWER IN EUROPE, *by Edward McCrensky, 188 pp., 1958, Pergamon Press, Inc., 122 E. 55th St., New York 22, N. Y. $6.50.*

A comparative study of scientific manpower in government agencies of selected European countries.

ENCYCLOPEDIA OF AMERICAN ASSOCIATIONS: *A Geographic Index Edition, 172 pp., 1959, Gale Research Co., Book Tower, Detroit 26, Mich. $15.00.*

Lists by state and city all national associations, professional societies, labor unions and other non-profit organizations, their address and name of chief official.

Hunter Awarded NATO Fellowship

Ralph E. Hunter of Johns Hopkins University was recently awarded a postdoctoral fellowship for study at the University of Paris. Hunter was the only geologist among the 41 recipients of the North Atlantic Treaty Organization (NATO) Postdoctoral Fellowships in Science. The program is administered by the National Science Foundation and the Department of State.

1960 SCHEDULE OF FIELD TRIPS

For additional field trips held in conjunction with meetings, see those items marked with an asterisk under meeting calendar.

Aug. 3-5—WYOMING GEOL. ASSOC., trip to Big Piney-LaBarge area, Snyder Basin and Wind River Mtns. to study geology of westernmost Wyoming overthrust belt. Write: C. A. Burk, Box 1331, Casper, Wyo. Guidebook.

Sept. 1—FOUR CORNERS GEOL. SOC., trip to east-central Utah and west-central Colo. to study salt anticlines; write: K. G. Smith, P.O. Box 1501, Durango, Colo.

Sept. 7-10—BILLINGS GEOL. SOC., trip to Hebgen Lake earthquake and Madison slide of Yellowstone Park area to study local strat. and struct.; write: Richard L. Jodry, P. O. Box 219, Billings, Montana. Guidebook.

Sept. 8-10—INTERMTN. ASSOC. OF PETR. GEOLOGISTS—E. NEV. GEOL. SOC., joint field trip, to include the geology of East Central Nevada in the Ely region. Write: Walter M. Winfrey, Box 269, Ely, Nevada.

Sept. 9-10—FRIENDS OF THE PLEISTOCENE, field trips at Promontory Point (SP Railroad) gravel pit in Little Cottonwood Creek area (20 mi S of Salt Lake City). Lake Bonneville stratigraphy and correlations with glacial units. Write: R. B. Morrison, U.S.G.S., Federal Center, Denver, Colo., or H. D. Goode, U.S.G.S., 503 Federal Bldg., Salt Lake City, Utah.

Sept. 16-17—KANSAS GEOL. SOC., 25th Ann. Field Conf., trip to NE Oklahoma to study Atokan, Morrow, Upper Mississippian and Pre-Mississippian exposures. Write: Soc., Attn: Mr. Harvel White, 508 E. Murdock, Wichita, Kans. Guidebook.

Sept. 29-Oct. 1—WEST TEXAS GEOL. SOC., trip to Apache Mtns. and Delaware Basin to study oil fields and Permian system; write: Eugene Greenwood, P.O. Box 1600, Humble Oil Co., Midland, Tex. Guidebook.

Oct. 8-9—NEW ENGLAND INTERCOLLEGIATE GEOL. CONF., trip to west-central Maine to study strat. and struct. and correlation to E. New Hampshire; write: Andrew Griscom, Geophysics Branch, USGS, Washington 25, D. C. Guidebook.

Oct. 8-9—TRI-STATE GEOL. FIELD CONF., trip to north-central Iowa to study Mississippian strat. and shoreward phase of Penn. sections; write: Leo Thomas, Iowa State College, Ames, Iowa. Guidebook.

Oct. 14-16—NEW MEXICO GEOL. SOC., trip to Chama Basin area of N.-cent. N.M. to study strat. and econ. geology of rocks Precambrian through Tertiary. Assemble at Taos, Oct. 13, disband at Cuba. Write: Clay T. Smith, N.M. Inst. Min. & Tech., Socorro, N.M. Guidebook.

Oct. 19-20—GULF COAST ASSOC. OF GEOL. SOCS., trip of Coastal Mississippi and Alabama to study recent marine sediments and Cenozoic. Write: A. E. Blanton, P.O. Box 422, Jackson 5, Miss. Guidebook.

Oct. 22-23—FIELD CONF. OF PENNSYLVANIA GEOLOGISTS, trip to Appalachian Piedmont along Susquehanna R. to study struct. mechanisms. Write: Dr. D. V. Wise, Franklin & Marshall Coll., Lancaster, Penna. Guidebook.

Nov. 18-20—ROSWELL GEOL. SOC., trip to south-central New Mexico to study Pennsylvanian stratigraphy. Write: M. D. Wilson, Shell, Box 845, Roswell, N.M. Guidebook.

FIELD TRIP CALENDAR

Most of the information regarding field trips in this calendar appears through the courtesy and cooperation of the AAPG Field Trip Committee. Corrections, additions and new trip notices should be sent to George H. Fentress, Chairman, AAPG Field Trip Committee, P. O. Box 2585, Denver 1, Colo., with a carbon copy to GeoTimes Calendar, American Geological Institute, 2101 Constitution Ave., N.W., Washington 25, D. C.

CLASSIFIED ADS . . .

No. of times	*Rates per line per insertion* 1	2	4	8
POSITIONS WANTED	$0.50	$0.30		
VACANCIES	1.50	1.00		
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VACANCIES

GEOLOGIST, MS or Ph.D., to teach Paleontology and Structural Geology, and prepared to teach stratigraphy, sedimentation, optical mineralogy, micropaleontology, or other specialties in future years. Will have full freedom in determining content of courses. Must speak Spanish. Academic year begins Sept., 1960. Salary far from high, but compensated by unspoiled opportunities for field research. Inquiries, complete credentials, photo, to dept. of geology, Universidad de Oriente, Santiago de Cuba, Cuba.

TWO ONE-YEAR replacements to teach: 1. General Geology and possible Geomorphology. 2. Mineralogy and Petrology. Salary $6,000-$9,000, rank open. Appointment to begin Sept. 1960 to replace two men on leave of absence. Write to R. W. Lounsbury, Division of Geology, Purdue University, W. Lafayette, Indiana.

PHOTOGEOLOGIST: graduate degree and minimum of 4 years experience in all phases including geomorphology. Must be able to handle a program with minimum supervision. Apply with full resume to Box 120.

RESEARCH GEOPHYSICIST. Responsible position with major oil company available for well qualified research geophysicist. Ph.D. or equivalent experience. Preference will be given to those having some field experience. Should be capable of making original contributions. Good opportunities for advancement. Salary open. Reply to: Director, Exploration Research Division, Continental Oil Company, Ponca City, Oklahoma.

GROUND - WATER HYDROLOGIST - GEOLOGIST required to conduct hydrologic research program in Saskatchewan. Permanent position as of April 1, 1961 for well-qualified Ph.D. in hydrology-geology or summer position as of spring 1961 for Ph.D. candidate prepared to do thesis on Saskatchewan-hydrology. Summer position would recur and become permanent on completion of Ph.D. by suitable candidate. Applicants should describe qualifications and give references in writing to Director, Saskatchewan Research Council, University of Saskatchewan, Saskatoon, Saskatchewan and may contact Dr. E. A. Christiansen at International Geological Congress meetings in Copenhagen or at IUGG meetings in Helsinki.

GEOPHYSICISTS, preferably with experience in seismology—field and office positions at several levels—research laboratory in eastern U. S. Box 121.

PETROLEUM GEOLOGIST experienced in oil occurrence interpretation and exploration methods in new basins in responsible foreign post. Must be well recommended. Box 122.

LEAVE OF ABSENCE POSITION, one academic year starting September 1, 1960. Salary and rank open, depending upon training and experience. Teaching load 10 to 12 credits per semester; structural geology, elementary physical geology, geologic field methods, hand specimen petrology. For details apply to Edward L. Tullis, Department of Geology, South Dakota School of Mines and Technology, Rapid City, South Dakota.

POSITIONS WANTED

BOX 611. ASSISTANT PROFESSOR, Ph.D. major university wishes to teach in college or university in more desirable area. 3 yrs. teaching and 6 yrs. varied industrial experience. Primarily interested marine geology, paleontology, sedimentation, mineralogy. Active researcher, member prof. societies. Resume on request.

BOX 640. PETROLOGIST, 38, Ph.D. '52.

BOX 646. GEOLOGIST, broad exploratory background in the Four Corners, Panhandle and West Texas. Eight years experience includes subsurface, administration and seismograph. Some field and well work. Desires more responsibility.

BOX 703. GEOLOGIST, Ph.D. (Minn.), 40, with a large and happy family. Eight seasons in varied polar work, mostly in the Canadian Arctic; four years University teaching in Introductory Geology, Geomorphology, Photogeology, Glacial and Pleistocene Geology; and four years University Extension teaching in Physical Geology, Mineralogy, Rock Study, and Glacial and Pleistocene Geology; am currently teaching. Member of various professional societies, Sigma Xi, and Phi Beta Kappa. Desire to teach in N. central, N.E., or S.W. U.S. Available in summer/fall, 1960.

BOX 730. PALEONTOLOGIST-STRATIGRAPHER. Desires permanent teaching position. 11 years teaching experience in paleontology, stratigraphy, sedimentology, historical geology. Publications. Available Sept. 1960.

BOX 735. ASSOCIATE PROFESSOR, Ph.D. major college. Principle interests in sedimentary petrology, sedimentation and micropaleontology, wishes to relocate in southwest or west, either in teaching or in research llaboratories of major oil company. Preferably in large city. Six years experience with major oil company and five years teaching experience.

BOX 736. Ph.D., 32, GEOCHEMIST-Petrologist. Teaching at midwest university. Desires a change to a department with better research facilities and opportunities.

BOX 738. GEOLOGICAL ENGINEER, 34, Ph.D., Univ. of Calif., economic geology, petrology, structure and vulcanology, adequate background, university teaching, several seasons mineral exploration and three years consulting, wants challenging teaching and/or research position.

BOX 739. GEOLOGIST, Ph.D., 34, married. Five years with foreign, national industrial planning agency as economic geologist and adviser mineral resources development; also university and post-university experience basic and applied research economic geology. Desires teaching position with college or university with adequate library and other facilities for research in geosciences OR research position in industry. Details on request.

BOX 741. GEOLOGIST-33, single, excellent health; Ph.D.; fluent 5 languages; 6 years experience examining prospects, organizing mineral exploration; several discoveries; wants foreign assignments evaluating prospects.

BOX 746. GEOLOGIST, Ph.D., structural geology, sedimentary petrology, economic geology including exploration and evaluation techniques. Thirteen years experience in North and South America. Desires university position.

BOX 748. EXPLORATION GEOLOGIST, Ph.D. Degrees in mining engineering and geology. 10 years field work with Canadian Geological Survey and Quebec Department of Mines. Teaching experience in physics and geology. Publications, physics and geology. Professional engineer. Six years geologic exploration in Venezuela and Brazil. Desires foreign work.

BOX 749. GEOLOGIST, M.S. (1955), 32, family, urgently desires permanent position in the fields of either petroleum geology, teaching, mineral industry, ground water, or survey work. Good references and academic record. Recent recipient of National Science Foundation grant. Graduate work in hardrock geology and petrographic microscope. Professional experience: U.S.G.S.; 3 yrs. foreign employment in surface and subsurface petroleum geology; and college level geology teaching. Resume on request. Will appreciate interview opportunity.

BOX 750. GEOLOGIST, 23, B.S., M.S. in June, desires permanent petroleum or mineral exploration work abroad.

BOX 751. GEOLOGIST, 34, Ph.D. Six years micropaleontologic, stratigraphic and petroleum exploration experience, both laboratory and field. Interested in teaching or general geological work with a small company or survey.

BOX 752. GEOLOGIST, B.A. Petroleum, M.A. Stratigraphy; foreign experience, Antarctic exploration, major oil companies; Arabic, English, French, Spanish; family; prefer Middle East, Latin America.

BOX 753. GEOLOGIST, M.S., 28, family, veteran. Hydrogeochemical and hyrdological background. Also computer and technical writing experience. Primarily interested in foreign work. Will consider domestic. Resume on request.

BOX 754. MINING-ENGINEERING GEOLOGIST, 10 yrs. diversified surface, subsurface experience with metallic and non-metallic mineral deposits, also experienced as Engineering Geologist on flood control projects. Available for domestic or foreign assignments, preferably with progressive American concern. M.A., family, veteran. Resume upon request.

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